VOL. II AUGUST 1951 NO. 8

UNITED STATES ARMED FORCES MEDICAL JOURNAL

Published Monthly by the Armed Forces Medical Publication Agency, Department of Defense

WAYNE G. BRANDSTADT, *Colonel, MC, U. S. A., Editor-in-Chief*
ROBERT J. BENFORD, *Colonel, U. S. A. F. (MC), Associate Editor*
HAROLD A. LYONS, *Commander, MC, U. S. N., Associate Editor*

THE PRINTING OF THIS PUBLICATION HAS BEEN APPROVED BY THE DIRECTOR OF THE BUREAU OF THE BUDGET, OCT. 19, 1949

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1951

For sale by the Superintendent of Documents, U. S. Government Printing Office
Washington 25, D. C.

Foreword

The UNITED STATES ARMED FORCES MEDICAL JOURNAL represents the unification of the BULLETIN OF THE UNITED STATES ARMY MEDICAL DEPARTMENT and the UNITED STATES NAVAL MEDICAL BULLETIN. This joint periodical is the medium for disseminating information of administrative and professional interest to all medical personnel of the Department of Defense.

The Chairman of the Armed Forces Medical Policy Council and the Surgeons General of the several services invite all medical officers, dental officers, Medical Service Corps officers, Nurse Corps officers, and officers of the Veterinary Corps of the Armed Forces, and the medical consultants of the Army, Navy, and Air Force to submit manuscripts for publication in this JOURNAL.

W. RANDOLPH LOVELACE, II, M. D.,
Chairman, Armed Forces
Medical Policy Council,
Department of Defense.

GEORGE E. ARMSTRONG,
Major General, U. S. A.,
Surgeon General, U. S. Army.

LAMONT PUGH,
Rear Admiral, MC, U. S. N.,
Surgeon General, U. S. Navy.

HARRY G. ARMSTRONG,
Major General, U. S. A. F.,
Surgeon General, U. S. Air Force.

NOTICE TO CONTRIBUTORS

Contributions to the MEDICAL JOURNAL should be typewritten, double-spaced with wide margins on plain paper of standard letter size. Nothing should be written in the manuscript that is not intended for publication.

The MEDICAL JOURNAL endeavors to follow a uniform style in headings, captions, spelling, abbreviations, capitalizations, and the use of figures as set forth in the Government Printing Office Style Manual.

All illustrations should be unmounted. Pictures, prints, or drawings may be fastened on a sheet of paper by means of angular slits for each corner of the illustration; suitable identification can then be made on this sheet. Do not cut out portions of an illustration for reproduction. Photographs should be black and white glossy prints, preferably 4 by 5 or 8 by 10 inches to allow for reduction. Do not make any marks on the face or back of the photographs or drawings. Cellophane tape, staples, paper clips, or pins should not be used on illustrations. All charts and graphs must be drawn with black india ink on white paper; graph lines must not be in green or blue ink.

Contributions are to be the original work of the author. Quotations must be accurately and carefully copied and full credit must be given to the source. References, tables (charts), and legends must be double-spaced and on separate sheets. References should be listed according to the Quarterly Cumulative Index Medicus, A. M. A., and the sequence should be as follows: name of the author and initials; title of article; name of periodical; volume number; pages; and month and year. *Example:* Hinton, D., and Steiner, C. A.: Recurrent volvulus of sigmoid colon; unusual case report. Ann. Surg. 116: 147–149, July 1942. Authors are responsible for the accuracy of the bibliographic references.

The summary should be a factual and brief recapitulation of the observations or statements contained in the article. The conclusions drawn from the case, experiment, or facts set forth should be clearly stated and should appear at the close.

The editor is not responsible for the safe return of manuscripts and illustrations. All material supplied for illustration, if not original, must be accompanied by reference to the source and a statement that reproduction has been authorized. Recognizable photographs of patients should carry permission to publish.

All original contributions are accepted on the assumption that they have not appeared previously and are not to be reprinted elsewhere without the permission of the Editor, UNITED STATES ARMED FORCES MEDICAL JOURNAL, and that editorial privilege is granted to the UNITED STATES ARMED FORCES MEDICAL JOURNAL in preparing all material submitted for publication. Authors are urged to keep their articles short.

Address: U. S. Armed Forces Medical Journal, Bureau of Medicine and Surgery, Department of the Navy, Washington 25, D. C.

WAYNE G. BRANDSTADT, *Editor-in-Chief,*
Colonel, Medical Corps,
United States Army.

ROBERT J. BENFORD, *Associate Editor,*
Colonel, Medical Corps,
United States Air Force.

HAROLD A. LYONS, *Associate Editor,*
Commander, Medical Corps,
United States Navy.

Table of Contents

	Page
Dr. Meiling Awarded Certificate of Appreciation	1123
Thoracic Injuries in World War II: I. General Considerations, Alterations of Pulmonary Physiology, and Therapy in the Initial and Reparative Phases—*Howard K. Gray* and *James D. Fryfogle*	1127
Electromyography—*Arthur E. White* and *James D. Amos*	1151
Treatment of Frostbite of Toes—*John B. Irwin* and *Herbert Schultz*	1161
Banthine in the Treatment of Duodenal Ulcer—*Morgan M. Meyer* and *Julian A. Jarman*	1165
Thrombophlebitis—*Jack T. Rush* and *James H. Forsee*	1169
Hydrophilic Forms of Tars—*Solomon C. Pflag* and *Louis C. Zopf*	1177
Tantalum Foil Used in Closing Antro-Oral Fistulas—*Earle J. McClung* and *James E. Chipps*	1183
The Improvement of Professional Relations in Hospitals—*Richard A. Kern*	1187
Accomplishments of Naval Dental Research—*Carl A. Schlack*	1195
Decompression Sickness: Report of Two Unusual Cases—*Walter Welham* and *Charles L. Waite*	1201
Liver Suture—*Richard S. Silvis*	1205
Clinicopathologic Conference	1213
Concealed Delayed Hemorrhage—*James T. Helsper, Alfred O. Heldobler,* and *Robert C. Anderson*	1221
Pregnancy in the Right Side of a Double Uterus—*George W. Markus*	1227
Amebiasis: Evaluation of New Therapies—*Ryle A. Radke*	1231
Craniotomies in Korea—*Gale Clark*	1235
X-ray Cones from Shell Casings—*Wilson R. Scott*	1239
Portable Field and Aircraft Inhalator—*Russell G. Witwer, Joseph E. Ganci,* and *Harold B. Wright*	1243

Page

Bacitracin and Gelfoam: Combined Use in Dentistry—*Albert D. Alexander* 1247

Tularemia—*Norris A. Wimberley, Jr.* 1251

BOOKS RECEIVED 1255

BOOK REVIEWS 1259

Articles by Personnel of the Medical Services of the Armed Forces Published in Other Journals 1164, 1182

OFFICE OF THE SECRETARY OF DEFENSE
ARMED FORCES MEDICAL POLICY COUNCIL
WASHINGTON 25, D.C.

MEMO: Personnel of the Medical Services of the United States Armed Forces

Research in the Armed Forces combines all the investigative aspects of medicine. Its allied sciences contribute to the physical, mental, and psychologic health and care of military personnel and to the integration of men and weapons into military units. The care of the wounded and the care of patients with conditions peculiar to combat require a great deal of clinical and basic research best done by those associated with combat situations.

Many problems such as frostbite and hepatitis require continued study. A splendid contribution to medical knowledge of vital importance to civilian and military physicians was the field research problem accomplished by the specially trained and selected Army Wound Ballistic Research Units attached to military hospitals in the Far East Command. Excellent data regarding the regional incidence of wounds and type of missile involved were obtained and the data disseminated through the Theater Surgeon. Specific orientation of medical officers in the basic knowledge of wounds, classification of weapons, and missile identification will be possible as a result of this study.

There are many other field medical research problems involving personnel and equipment that can be carried out only in combat areas. Here the line of demarcation between military and civilian medical research is sharp. The result of such research will have a wide and often immediate application.

W. Randolph Lovelace, II

W. Randolph Lovelace, II, M. D.
Chairman

UNITED STATES ARMED FORCES
MEDICAL JOURNAL

Volume II August 1951 Number 8

Dr. Meiling Awarded Certificate of Appreciation

ON 29 June 1951 the Secretary of Defense, General Marshall, presented the highest civilian honor of the Department of Defense—the Certificate of Appreciation—to Dr. Richard L. Meiling, whose resignation as Chairman of the Armed Forces Medical Policy Council became effective 30 June (fig. 1). Mrs. Meiling and ranking civilian and military officials of the Department of Defense witnessed the ceremony. The citation to accompany the award is shown in figure 2.

Dr. Meiling tendered his resignation as Chairman of the Armed Forces Medical Policy Council in order to return to his professional, clinical, and academic responsibilities. His leave of absence from Ohio State University College of Medicine expired on the effective date of his resignation from the Defense Department. In accepting Dr. Meiling's resignation, General Marshall stated that he did so with regret, adding, "You have very ably discharged a difficult role in unification, in developing a coordinated medical program for the Army, Navy, and Air Force without loss of the individual medical service independence necessary to the combat mission of each service. I am most reluctant to release such a competent advisor and executive as you have proved to be."

Dr. W. Randolph Lovelace II, succeeded Dr. Meiling as Chairman of the Armed Forces Medical Policy Council. A member of the Council during Dr. Meiling's tenure as Chairman, Dr. Lovelace was succeeded on 1 July, by Dr. Alfred R. Shands, Jr. who with Dr. I. S. Ravdin, Dr. J. P. Hollers, Dr. Lovelace and the Surgeons General of the Army, Navy, and Air Force compose the Council.

Dr. Meiling's contributions toward "effective mobilization of the nation's civilian health resources" as well as those of the Armed Forces

Figure 1.—Dr. Meiling (center) receiving Department of Defense Certificate of Appreciation from Secretary Marshall. Deputy Secretary of Defense Lovett is standing at the left.

THE SECRETARY OF DEFENSE
WASHINGTON

CITATION TO ACCOMPANY THE AWARD OF THE

DEPARTMENT OF DEFENSE

CERTIFICATE OF APPRECIATION

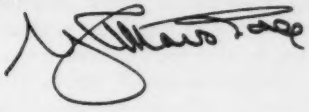
TO

RICHARD L. MEILING

RICHARD L. MEILING, for outstanding service performed for the Department of Defense and his country from November 1948 through June 30, 1951. Appointed by the first Secretary of Defense in November 1948 to be a member of the Armed Forces Medical Advisory Committee, Dr. Meiling served in this capacity until July 6, 1949, when he was appointed Deputy Director of Medical Services. With the establishment of the Armed Forces Medical Policy Council on January 2, 1951, Dr. Meiling was appointed the first Chairman of this Council.

Specifically responsible for coordination of the medical and health policies, programs and affairs of the Department of Defense, he has devoted himself tirelessly to the accomplishment of this mission. His ability to take the initiative on difficult and controversial matters and to carry these programs to a successful conclusion has contributed much to the unification of the medical services in the Department of Defense. His devotion to duty and his zeal for the national security have been outstanding.

In recognition of his service, the Department of Defense awards to Richard L. Meiling its highest civilian honor -- the Department of Defense Certificate of Appreciation.



29 June 1951

Figure 2.

were lauded also in a resolution by the Health Resources Advisory Committee of the Office of Defense Mobilization. The resolution, adopted 28 June, said:

"Be it resolved that the Health Resources Advisory Committee of the Office of Defense Mobilization express its deep appreciation and gratitude to Dr. Richard L. Meiling, Chairman, Armed Forces Medical Policy Council, for his splendid cooperation.

"Dr. Meiling's insight, ability, and understanding of the implications of the mobilization of military medical manpower, supplies, and facilities upon the Nation's civilian health resources have been a major factor in the Health Resources Advisory Committee's ability to meet its responsibilities. His tremendous contribution to the Nation's defense has not been limited to the Nation's military services, but has contributed greatly to more effective mobilization of the Nation's civilian health resources during this period of emergency."

Thoracic Injuries in World War II

I. General Considerations, Alterations of Pulmonary Physiology, and Therapy in the Initial and Reparative Phases (1)

Howard K. Gray, *Captain, MC, U. S. N. R.* (2)

James D. Fryfogle, *M. D.* (3)

THE opportunities presented during World War II for the treatment of thoracic injuries were without parallel in medical history. The literature of the past 5 years is replete with reports from the many small installations, field hospitals, and thoracic centers of all the allied armed services. In most instances, these reports concern the patients treated by the group reporting, the success of the methods used, and the mortality and rehabilitation statistics. More specifically, they cover first-aid measures, treatment of shock and other early complications, emergency procedures, the problem of foreign bodies within the thorax and in the thoracic wall, reconstructive surgery, and the definitive treatment of late complications and conditions. This accurate reporting of results and methods by a large group of conscientious physicians who, in many instances, were working under extremely difficult and hazardous conditions, has furnished a wealth of pertinent information which is of inestimable value in the ever-expanding field of thoracic surgery.

Many of the barriers that stayed the hand of the surgeons in World War I have been surmounted. Infections, which killed more men than did bullets in the Civil War, no longer were found to be the principal cause of death. A review of the many statistical surveys of casualties in World War II reveals that wounds of the thorax comprised about 6 percent of all war wounds. The total mortality rate for all war wounds averaged about 8 percent but wounds of the thorax accounted for over

(1) Part II, Therapy in the Reconstructive Phase, by Joseph P. O'Connor, Commander, MC, U. S. N. R., will appear in the September issue of this journal; and Part III, The Surgical Treatment of Traumatic Lesions of the Intrathoracic Cardiovascular Structures, by Herbert D. Adams, Commander, MC, U. S. N. R., in the October issue.

(2) Mayo Clinic, Rochester, Minn.

(3) Formerly Fellow in Surgery, Mayo Foundation, Rochester, Minn.; now living in Detroit, Mich.

32 percent of this mortality. Thus it can be seen that, although there was a relatively low incidence of thoracic wounds in relation to the size of the area exposed to trauma, there was an extremely high mortality rate in the group of those injured in this region.

Table 1 shows the mortality rate in patients with thoracic wounds who were brought in for treatment in various wars prior to World War II. What the mortality rate would be for all persons with thoracic injury is not known because the nature and extent of the wounds of many persons killed in combat could not be determined.

TABLE 1.—*Mortality rate from thoracic wounds in wars prior to World War II*

War	Mortality rate (percent)
Crimean	79.2
American Civil	62.6
Franco-Prussian	56.7
Spanish-American	24.5
Boer	14.9
World War I	27.5
Sino-Japanese	14.8

In World War II, chemotherapy, a clearer concept of the abnormal physiologic processes associated with thoracic injury, and adroit and audacious surgical treatment combined not only to preserve life but also to restore the patient with a once-fatal condition to normal or functionally nearly normal. The interval between injury and treatment, always a factor which, when prolonged, made surgical correction impotent, was greatly shortened by having at hand skilled hospital corpsmen and medical officers in the forward areas. Adequate and available materials for the immediate replacement of lost blood or plasma, or both; accurate evaluation by front-line medical officers as to the type of treatment indicated; and rapid transportation to a well-equipped hospital in which every known method of treatment could be prescribed were additional factors which contributed greatly to the lowered mortality rate and the shortened period of morbidity. With reference to thoracic injuries much credit should be given to the administrative plan of segregating such injuries, in order that the exacting care and the diagnostic and therapeutic measures needed to achieve the best results in lesions of the chest would be available.

We propose in this report to present a condensation of the recent literature, to record in some detail the methods used in World War II with such gratifying results, and to outline what we believe to be a practical approach to the treatment of thoracic wounds. It is hoped that this presentation may furnish a working guide to medical personnel

of the Armed Forces whose contact with such injuries may have been casual. Credit is given to authors for employment of various technics but no attempt has been made to establish originality of methods.

Primarily, we are concerned with three questions: (1) What conditions must we be prepared to treat? (2) When do we treat them? and (3) How do we treat them? Although answers to all three questions in an individual case must be modified by the location of the injured person and available personnel and equipment, all units must be prepared to treat shock, control hemorrhage, institute measures to combat infection, and support respiratory function.

CONDITIONS TO BE TREATED

Shock.—From the therapeutic viewpoint it is well to consider shock as occurring in two phases. The first is primary shock which immediately follows injury and has a nervous component in which the pain and the psychic factors of the trauma produce the syndrome by their action on the vascular system. The second phase is the secondary or surgical shock which occurs from 2 to 4 hours after severe tissue injury and is characterized clinically by a profound fall in blood pressure, pallor and coldness of the skin, sweating, rapid shallow breathing, a weak rapid pulse, and other less obvious manifestations of circulatory collapse. Secondary shock has been attributed to a variety of conditions which include acapnia, fat embolism of the higher centers, a toxic substance or substances released from the site of trauma, and the loss of blood or plasma, or both, from the circulation. Only the last theory has been supported completely by experimental investigation, so that fundamentally secondary shock now is accepted widely as being caused by an inadequate volume of circulating blood irrespective of the cause of this decreased volume which, if allowed to progress, may produce hypoxemia, anoxia, and death. Nervous influences and toxic substances may be contributory causes.

The treatment of traumatic shock includes relief of pain, recognition and correction of the source of the lost fluid, restoration of the lost fluid, and protection of the patient from cold, anxiety, and apprehension. In patients with thoracic injuries, restoration of normal cardiorespiratory physiologic processes in itself will greatly augment the abolition of shock. Agents such as posterior pituitary extract, which constrict the capillary bed, may be indicated owing to the puddling of blood at such sites. Agents, such as epinephrine, which constrict the arterioles usually are *not* indicated, because the arteriolar tone may be increased as a compensatory effort of the body to correct the hypotension. Any additional arteriolar tension will only increase the tendency to puddling in the capillary bed and thus reduce even further the amount of blood in actual circulation.

Hemorrhage.—The volume of blood in a man weighing 70 kg. is about 6,300 cc. When more than 30 percent of this volume is lost rapidly and

is not replaced immediately by transfusion, death usually occurs. The protective mechanisms which automatically come into action after hemorrhage are a fall in arterial blood pressure, clotting, increase in heart rate, increased respiration, arteriolar constriction, and redistribution of blood. The latter produces the pallor and coldness of the skin seen clinically as a result of the attempt on the part of the defensive mechanism to divert the available blood from the surface of the body to the more vulnerable and vital regions. Thus, in a patient who has experienced a marked loss of blood, the clinical findings are those of secondary or surgical shock.

We must realize, however, that there are several major differences that influence therapy. In shock caused primarily by hemorrhage (whether apparent or hidden), control of the bleeding and the immediate restoration of blood by transfusion will usually correct the abnormal state, elevate the blood pressure, and the improvement will be *maintained.* In shock caused primarily by trauma when actual loss of whole blood has not occurred in appreciable quantities, the beneficial effects of transfusion of whole blood are usually of short duration and the blood pressure may fall off to shock levels at the cessation of what should be adequate replacement. These phenomena are probably caused by hemodilution that occurs in massive hemorrhage in contrast to the hemoconcentration which is seen frequently in traumatic shock. In those persons who have sustained injury to the thoracic cage or its contents, bleeding from such vessels as the intercostal or internal mammary vessels and bleeding from hilar vessels must be controlled immediately. Bleeding from the parenchyma of the lung will be discussed under the section devoted to the physiology of the pleural space.

Infection.—For practical purposes all wounds of the chest must be considered to be potentially infected. Penetrating wounds usually are contaminated by the introduction of foreign bodies, such as bullets, metallic fragments, clothing, dirt, or skin. Blast or crush injuries without penetration may result in infection of the pleural space by traumatic communication with the lung, bronchi, or esophagus and the subsequent release of the pathogens usually found in these structures. The empiric use of sulfonamides and antibiotics, applied locally but preferably administered parenterally to insure a protective level in the blood, has proved its effectiveness.

It should be recognized that the reports of cultures made from pleural contents are notoriously misleading, as the infection frequently becomes localized in only a few sites within the pleural space. This has been proved at operation when successive negative cultures have been taken from various regions. Pathogenic organisms may lie latent in a fibrin clot and elude the needle that has been inserted to obtain material for bacteriologic study.

The bacterial flora of the bronchi and bronchioles is varied. No single organism appears to be responsible for the infectious processes usually observed. Those most commonly obtained on culture, especially in cases of chronic infection, are alpha, beta, and gamma strains of hemolytic streptococci, *Staphylococcus aureus* and *Pseudomonas aeruginosa.* Less frequently found are *Escherichia coli, Aerobacter aerogenes,* and *Proteus vulgaris.* Infections that go on to suppuration commonly contain anaerobic streptococci, fusiform bacilli, and spirochetes *(Borrelia vincentii).*

The presence of these virulent pathogens plus the added contamination of the wounds by an endless variety of local organisms makes the institution of measures to combat infection mandatory at the earliest opportunity. The value of the sulfonamides and antibiotic substances in acute surgical infections is now well established. Adequate dosage at the onset may thwart the development of the more complicated mixed chronic infections that demand more specific therapy. Since wars of today are world wars in the geographic sense, fungi and the organisms encountered in tropical diseases must be included in our bacteriologic thinking.

Alterations in respiratory physiology.

1. Pneumothorax.—In the normal adult, "negative" pressure exists in the potential space between the visceral and parietal pleura. This so-called negative pressure has reference to the atmospheric pressure and varies with inspiration and expiration, the average variation between respiratory excursions being 4.5 mm. of mercury.

The thoracic cage from the first breath of life assumes a size greater than that of the lung which it contains. Thus, in order that pleural surfaces may remain in apposition, which is the condition seen in normal persons, the lung must expand. Negative intrapleural pressure is of importance therefore because it maintains expansion of the lung and it promotes the return of venous blood to the heart. When either pleural surface is punctured, atmospheric air is permitted to enter the pleural space and a pneumothorax is said to exist. If there is no communication to the atmosphere, except through the bronchial tree, it is termed a "closed" pneumothorax. If an atmospheric communication exists through the chest wall, it is termed an "open" pneumothorax.

Following the development of a closed pneumothorax, several complicating phenomena may be observed. By forced expiratory effort against a closed or partially closed glottis (as in the act of coughing), air is forced through the aperture which communicates with the pleural space and the bronchus or one of the smaller bronchioles and tension develops within the pleural space which may be many times atmospheric pressure (fig. 1). Under these circumstances the lung on the affected side may be almost completely contracted and compressed and the mediastinal structures are forced toward the unaffected side

Figure 1.—Tension pneumothorax on the right with retained fragments.

with partial compression of the lung on that side. The diaphragm is also displaced downward and acute dilatation of the stomach may occur (fig. 2). "Swing" of the mediastinal structures, to be described subsequently, is prevented by the tension within the pleural space.

Following open pneumothorax two serious complications occur: (1) the negative intrapleural pressure is lost thus permitting the lung to contract, and (2) a varying degree of obstruction to the return of venous blood to the heart occurs. If the puncture of the chest wall is smaller than the opening of the glottis, the intrabronchial air will continue to aerate the lung in its partially contracted state and respiratory impairment will be minimal (fig. 3). Only partial contraction usually occurs on the affected side because insufficient time elapses for outside air to enter the pleural space through the small aperture in the chest wall before expiration forces it out. Tension pneumothorax will not develop under these circumstances because the tension within the pleural space cannot rise above atmospheric pressure except momentarily during forced expiration. The pumping action observed in closed pneumothorax is absent for there is no communication with the intrapulmonary air passages; consequently the only source of air is through

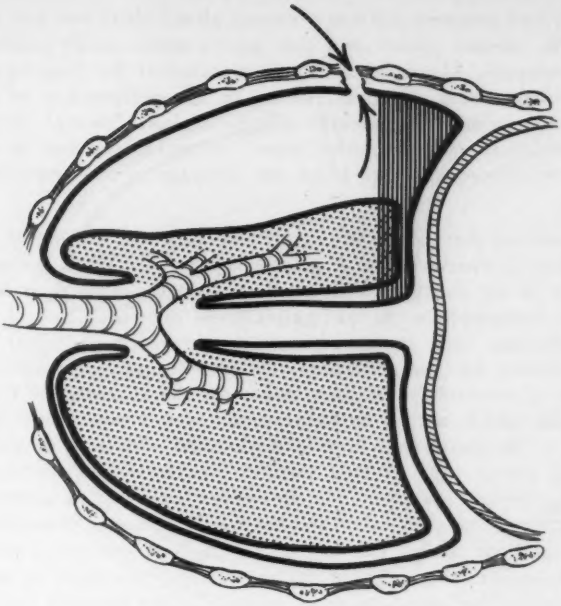


Figure 3.—Open pneumothorax with a small external opening.

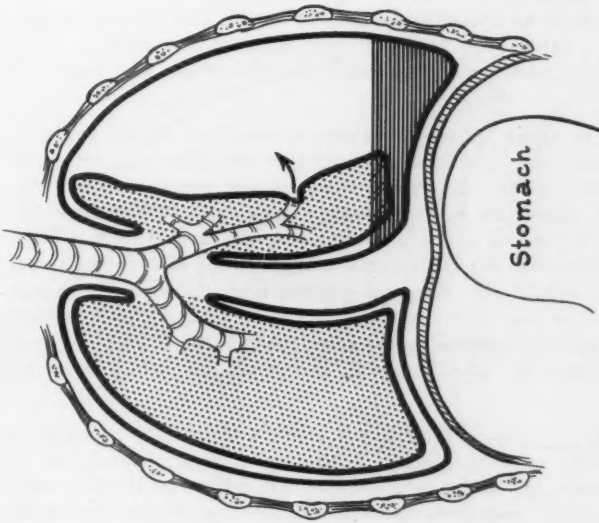


Figure 2.—Closed pneumothorax with tension.

80522 O - 51 - 2

the chest wall and pressure against a closed glottis does not add any more air to the pleural space than that which enters under ordinary atmospheric pressure. Almost complete contraction of the lung on the affected side may occur, however, owing to the obliteration of the negative pressure within the pleural space. Minimal "swing" of the mediastinal structures occurs under these circumstances but is not of such severe consequence as when the opening in the chest wall is large.

If the aperture in the chest wall is greater than the opening of the glottis, the lung is contracted to a greater degree than when the traumatic aperture in the chest wall is small in diameter. On inspiration, the structures contained in the mediastinum are displaced toward the normally ventilating lung by the inrushing air which is under atmospheric pressure and which enters the pleural space through the large aperture in an attempt to compensate for the increase of intrathoracic volume which occurs on inspiration. In this way the degree of expansion of the unaffected lung is diminished with a reduction of its functioning volume (fig. 4). This amounts practically to paradoxical respiration, but in this instance it is the mediastinum that is unstable. On expiration, the reverse obtains and the mediastinum is drawn back towards the midline. This "flutter" or "swing" of the mediastinum greatly interferes with the return of venous blood to the heart by moderate angulation of the great vessels, especially the superior and inferior vena cavas. Because one of the major factors in the volume of cardiac output is the volume of cardiac intake or venous return, diminution of venous return is an extremely important step toward the failure of the circulation of an adequate quantity of blood. The chain of events resulting from a large open pneumothorax therefore may have a lethal outcome if these abnormal physiologic processes are not corrected rapidly.

In addition to these unique physiologic reactions which apply to thoracic injuries, one must not lose sight of the fact that the usual factors involved in the production of shock are operative also, for trauma of such magnitude as to produce a pneumothorax may be sufficient in itself to produce shock. A patient usually can tolerate a large open pneumothorax if the functional efficiency of the contralateral lung is not impaired by empyema or inflammatory disease, if the circulatory system is free of a disease process so that it can withstand the increased burden imposed by the physiologic loss of one lung, and if the mediastinum is "fixed" so that the to-and-fro motion does not occur.

2. "Stove-in" chest.—In the crushed chest, a number of ribs may be fractured, usually in many places. A separation or dislocation of the costocartilaginous or sternocartilaginous articulations is frequently associated with the fractures. Such injuries destroy the rigidity of the chest wall which is vital to the maintenance of a satisfactory respira-

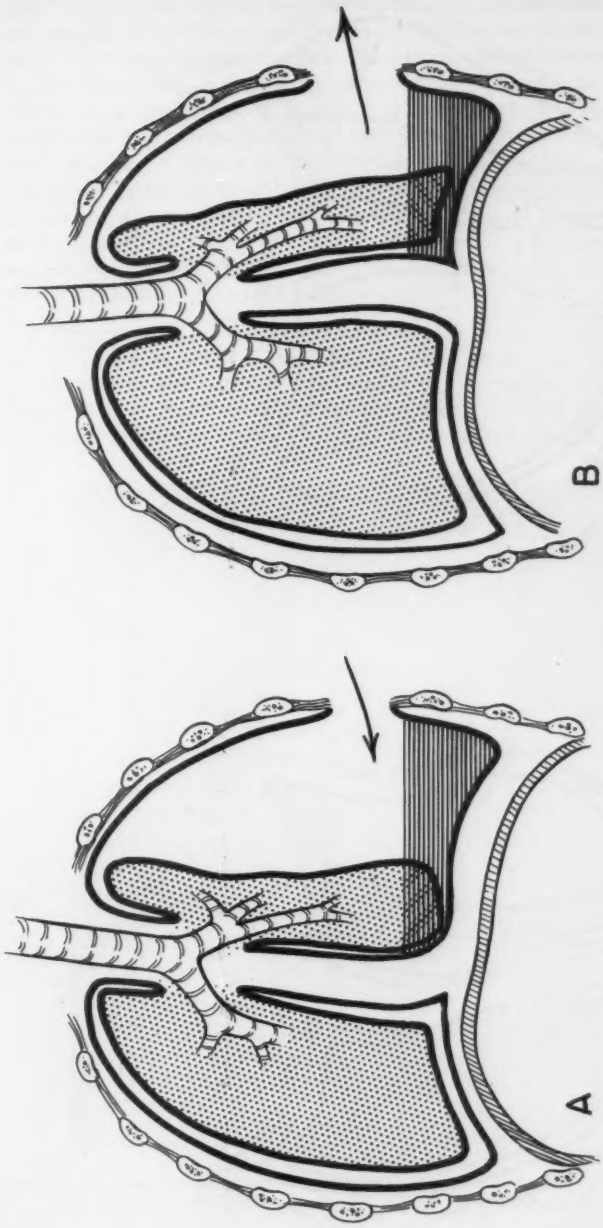


Figure 4.—Open pneumothorax with a large external opening. (A) Inspiration. (B) Expiration.

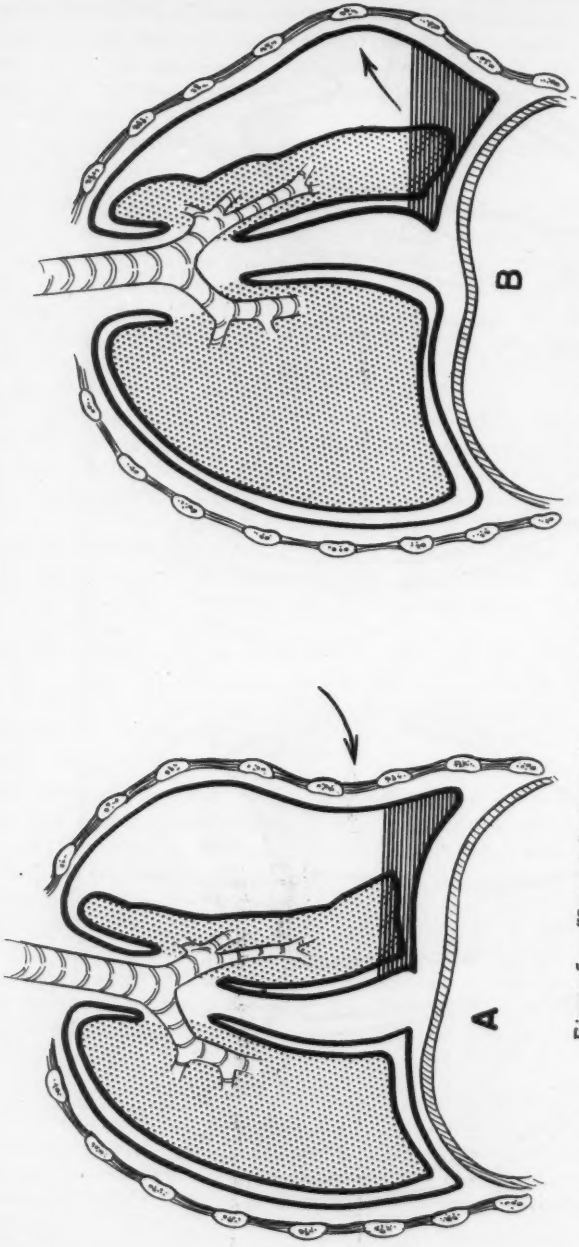


Figure 5.—"Stove-in" chest with a paradoxical response. (A) Inspiration. (B) Expiration.

tory exchange and produce what has been termed "paradoxical respiration." Normal inspiration depends on an increase of intrathoracic volume produced by elevation of the anterior portion of the ribs and the descent of the diaphragm. With the production of increased volume, air will enter the lungs under atmospheric pressure and will be extruded when the intrathoracic volume is reduced. If a portion of the chest wall has become detached from its bony structure, the involved area becomes indrawn on inspiration and protrudes on expiration (fig. 5)—a phenomenon which is just the reverse of that seen in normal respiration and one which may produce little or no change in intrathoracic volume, so that air will not enter the respiratory passages on inspiration nor will it be extruded on expiration. Such a condition is incompatible with life and must be corrected immediately.

3. Hemothorax.—The presence of varying amounts of blood in the pleural space is the rule and not the exception when thoracic injury has occurred. The source is as varied as the number of vessels contained in the chest wall or within the thoracic cage. Gross and progressive hemorrhage would indicate injury to the intercostal vessels,

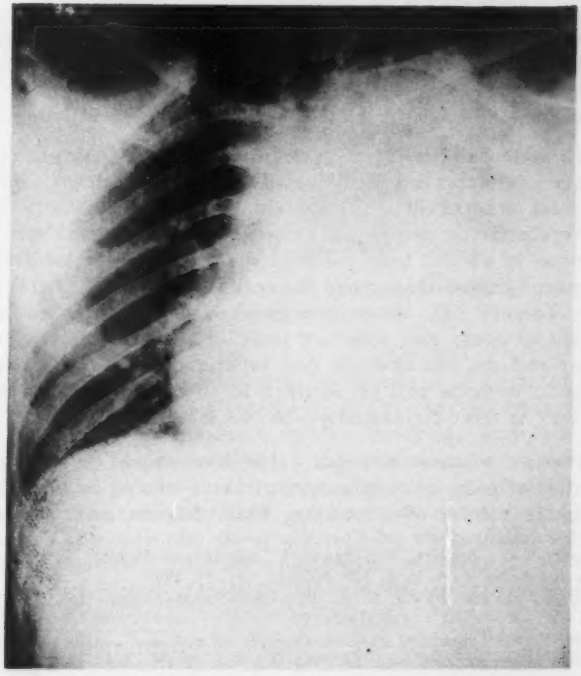


Figure 6.—Acute hemopneumothorax on the left with a shift of the mediastinum to the right. There is diffuse trauma to the underlying lung.

the internal mammary, or one of the larger vessels contained in the cardiorespiratory system, whereas the clinical evidence of hemothorax which shows no sign of progress or shows very slow increase in volume, would suggest that smaller vessels have been damaged and that the hemorrhage has been controlled spontaneously. The concomitant combination of blood, air, and serous exudate which is poured out as a result of direct trauma to the serous surfaces and irritation by foreign material in the pleural space is seen frequently and demands recognition (fig. 6).

WHEN TREATMENT IS TO BE GIVEN

The question of when to treat the various conditions is of the utmost importance. Although the management of thoracic injuries cannot be reduced to a simple formula but must be governed by the presence or absence of various factors in the individual case, it is well to have each member of the "team" aware of his facilities and capabilities. The "team" consists of all personnel who aid the patient from the time of injury until his final discharge from medical care.

Hospital corpsmen who see the patient first should be taught that sucking wounds should be closed immediately with a dressing large enough to stop the sucking noise, that a "stove-in" chest should be bandaged snugly, that the wounded man should be urged to cough if he has mucus in his throat and that he should be transported in a sitting position if he has difficulty in breathing when lying down.

When the patient is first seen by medical personnel at an aid clearing station, accurate appraisal of the extent of injury is urgent. The physician's first concern in the seriously ill thoracic casualty is how best to prepare the patient for safe evacuation to a forward hospital or ship. Samson et al. *(4)* have outlined the problem of immediate care of the wounded thorax. Dolley and Brewer *(5)*, Sanger *(6)*, Churchill *(7)*, Kent and Tebrock *(8)*, and others have described their methods of management of acute and subacute thoracic wounds. From these and many other authors, and from our own experiences, a logical sequence of diagnostic methods will be outlined in an attempt to answer when best and how to treat the casualty who has a seriously wounded chest.

Early therapy in advanced areas.—Morphine should be administered for the relief of pain, and replacement therapy should be begun to assure adequate volume of circulating fluid. Plasma may be the only

(4) Samson, P. C.; Burbank, B.; Brewer, L. A., III; and Burford, T. H.: Immediate care of wounded thorax. J. A. M. A. 129: 606-610, Oct. 27, 1945.

(5) Dolley, F. S., and Brewer, L. A., III.: Chest injuries. Ann. Surg. 116: 668-686, Nov., 1942.

(6) Sanger, P. W.: Evacuation hospital experiences with war wounds and injuries of chest; preliminary report. Ann. Surg. 122: 147-162, Aug., 1945.

(7) Churchill, E. D.: Surgical management of wounded in Mediterranean theater at time of fall of Rome. Ann. Surg. 120: 268-283, Sept. 1944.

(8) Kent, E. M., and Tebrock, H. E.: Posttraumatic hemothorax management. U. S. Nav. M. Bull. 45: 14-21, July 1945.

substance available but no substitute is as effective as whole blood when loss of blood has occurred. The first-aid measures instituted by hospital corpsmen should be checked. Open chest wounds must be sealed securely with petrolatum dressings, the stability of the chest wall insured by strapping, and an adequate airway realized by cleansing of the mouth and throat, including even the laryngeal area and upper part of the trachea if a suction apparatus has been improvised. Early and rapid evacuation of these patients is given a high priority but thought must be given to the problems of evacuation by air, particularly if high altitudes are to be flown, because patients with respiratory embarrassment will not tolerate rarified atmosphere nor the increase in volume of a pneumothorax that occurs in direct proportion to the altitude attained.

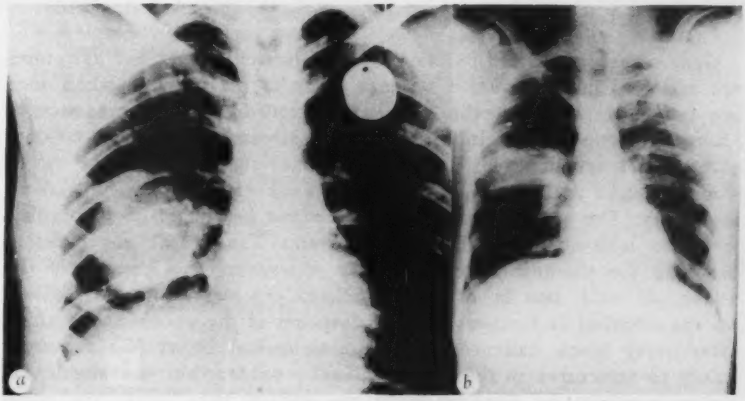


Figure 7. a *and* b. *Examples of blast injuries with focal destruction of the pulmonary tissue.*

Definitive therapy.—On his arrival at a hospital, the patient's status must be re-evaluated without delay by means of physical examination, roentgenograms if his condition permits, and accurate estimation of the features of the thoracic wound. Immediate attention is given those patients who, in spite of all the treatment that may have been instituted in the forward areas, present the problems of shock, sucking wounds, pain in the chest wall, anoxia, and mechanical difficulties in breathing. To determine those patients for whom immediate surgical treatment is mandatory, accurate diagnosis is essential. Most wounds are of two types: those resulting from penetrating fragments and those resulting from concussion or blast injuries (fig. 7).

It general it may be said of the second group that unless signs of continual blood loss, perforation of a viscus, or tamponade are present, surgical treatment should be delayed. Patients with pulmonary and cardiac contusion tolerate either anesthesia or surgical measures poorly. Several reports show clearly the value of withholding surgical

procedures in such circumstances in order that a reasonable diagnosis may be established to insure the patient's ability to withstand surgical treatment of such a serious nature.

In penetrating wounds one is concerned with the extent of the injury and so must plot as accurately as possible the course of the missile. The possible deflection from bony surfaces, the failure to find a wound of exit and the position of the patient when struck must be considered in this regard. It is essential to determine if the injury is limited to the thorax or if structures within the abdomen or neck or both are involved also. In view of the fact that multiple wounds are seen so frequently, it is essential that a complete examination be made in order that secondary wounds may not be overlooked when the focus of greatest interest is directed to the thoracic injury. The frequent diagnostic physical signs and symptoms are shown in table 2.

General notes relating to diagnosis.—Physical signs and symptoms are stressed in this outline because many of the patients when seen are too ill to tolerate other diagnostic procedures. The presence or absence of concomitant injuries of the abdomen or neck must be considered and sought for diligently. Abdominal rigidity occurring with a wound *limited to the thorax* is usually unilateral and on the *side* of the injury. The abdomen usually is somewhat *less* rigid on inspiration when *no* intra-abdominal injury is present. The simple expedient of blocking the thoracic nerves, thereby enervating this portion of the abdominal wall, may be of diagnostic aid. An abdomen that is silent on auscultation or the persistence of spasm of the abdominal muscles *after* nerve block indicates that intra-abdominal injury has occurred. Injury to structures in the neck is usually evident but one should examine carefully for emphysema of the mediastinum, neck, and chest wall, audible bruit, and signs of caval obstruction. The importance of accurately plotting the tract of the missile cannot be overemphasized as evidence obtained may be the deciding factor for or against immediate surgical intervention. If the patient's condition will permit the taking of roentgenograms, upright posteroanterior, upright lateral, and dorsal decubitus views of the chest, and a flat plate of the abdomen should suffice for the primary examination.

HOW TREATMENT IS TO BE GIVEN

The treatment of the thoracic casualty may be divided into three phases: (1) the initial or resuscitative phase, (2) the reparative phase, and (3) the reconstructive phase.

The methods of resuscitation as outlined by Samson et al. *(4)* adequately cover the major problems. Employment of these methods within the limits of personnel and equipment should be carried out by every group receiving patients with early traumatic lesions.

TABLE 2.—*Diagnostic signs and symptoms of chest wounds*

A. Thoracic concussion
   1. Shock } may or may not be present
   2. Loss of consciousness } may or may not be present
   3. Sighing respiration
   4. Cyanosis

B. Traumatic asphyxia
   1. Deep violet-blue discoloration of the face, neck, and upper part of the thorax
   2. Edema, especially of the lips and eyelids
   3. Skin dry and hot
   4. Stertorous respiration
   5. Visual disturbances

C. Blast injuries
   1. Bulging chest
   2. Normal percussion note (early)
   3. Distant breath sounds
   4. Bloody froth from mouth and nose
   5. Shallow prolonged respirations
   6. Restlessness
   7. Rigidity and splinting of the abdominal muscles simulating sudden peritoneal contamination

D. Pneumothorax (closed)
   1. Tympany on the affected side
   2. Tracheal deviation to the unaffected side
   3. Respiratory embarrassment with progressive cyanosis and increase of tension
   4. Distant breath sounds
   5. Shock

E. Pneumothorax (open)
   1. Sucking wound
   2. Respiratory embarrassment and cyanosis
   3. Shock

F. Hemothorax
   1. Tracheal deviation to the unaffected side
   2. Dullness on the affected side
   3. Absent or distant breath sounds
   4. Unrelenting shock if hemothorax is progressive
   5. Varying degrees of respiratory embarrassment with cyanosis

G. Hemopneumothorax
   1. As in hemothorax
   2. Shifting dullness and tympany
   3. Respiratory embarrassment and cyanosis, progressive if tension pneumothorax is present
   4. Shock

H. "Stove-in" chest
   1. Pleurisy type of pain on respiration
   2. Paradoxical respiration
   3. Respiratory embarrassment and cyanosis
   4. Bony crepitation at sites of fracture
   5. Shock

I. Tracheal or bronchial obstruction
   1. Physical signs of atelectasis
   2. Dyspnea and cyanosis
   3. Cough

J. Cardiac tamponade
   See section devoted to cardiovascular injury. Part III in this series to be published in October issue.

THERAPY IN THE INITIAL OR RESUSCITATIVE PHASE

The resuscitative triad as recommended by most observers includes in the order of their importance: (1) the restoration of cardiorespiratory balance by the stabilization of the thoracic cage, elimination of pain in the chest by blocking the appropriate intercostal nerves, tracheal aspiration of the "wet" lung, aspiration of blood when hemothorax is present, water-seal drainage of tension pneumothorax, and the administration of oxygen for anoxia, (2) replacement of fluids, and (3) early control of infection. The immediate correction of the cardiorespiratory imbalance is the most important single factor in aiding these patients. Although other resuscitative measures may be started simultaneously, the sealing of a sucking wound, return of the mediastinum to the midline by aspiration of pleural contents (air or fluid or both), establishment of an unobstructed airway, and the relief of pain should be the first considerations.

The extremely restless, apprehensive, and dyspneic patient is usually anoxic from loss of blood (either external or into the pleural space) and from his decreased vital capacity caused by compression of the lung by fluid or air or both and by atelectasis of the lung from blockage of the pulmonary radicles by excessive bronchopulmonary secretions. His efforts to rid himself of these burdens to normal breathing are further hindered by the intense pain that accompanies every voluntary effort. Therefore, his cough is feeble and ineffectual and the anoxia increases.

Oxygen by nasal catheter.—Oxygen may be administered by a 12 to 18 F. catheter which is attached to a portable oxygen tank. The flow should be 7 to 8 liters per minute. The apprehensive patient tolerates a catheter much better than a mask.

Catheter aspiration of the trachea.—In our experience this is best accomplished by use of a flexible woven catheter with a thumb suction release. The catheter is passed under the directing forefinger into the larynx. This is done without anesthesia and the maneuver is facilitated if the patient's tongue can be pulled out with a gauze square. If an ordinary rubber catheter is used, it is best to clamp the tubing with a hemostat, thus preventing suction until the tip has been introduced into the trachea. While the initial aspiration may bring marked relief by the removal of blood and mucus, repeated aspirations are of value especially after nerve block when the uninhibited cough of the patient proves to be of great assistance. The pulmonary edema seen after blast and concussion injuries may persist for a number of days. With subsidence of the shock syndrome, bronchoscopy may be performed as frequently as twice a day, if needed. Oxygen, delivered at the rate of from 4 to 6 liters per minute under positive pressure by means of a close-fitting mask, is a valuable procedure. Unless the tracheobronchial tree is free of secretions, the administration of oxygen under positive pressure is of little benefit in the treatment of pulmonary edema.

Regional nerve block.—This procedure may be accomplished by the intradermal injection of a 1 percent solution of procaine over the angle of the involved rib or ribs, including the two rib segments above and the two rib segments below the injury. Through these skin wheals, a 2-inch 20 to 22 gage needle is introduced down to the body of the rib. The lower edge of the rib is found and from 5 to 8 cc. of a 1 percent solution of procaine are injected. The relief of pain is immediate and amazing. The patient is able to cough more effectively and to aerate the lung more efficiently. Regional block is preferred to injection into the site of the open wound because of the possible contamination. In nonpenetrating fractures of the ribs, injection of the resultant hematoma has given some relief. Strapping of fractured ribs, as a means of affording relief from pain, is markedly inferior to the blocking of the appropriate nerve or nerves but is frequently used as an adjunct after blocking of the nerves has been accomplished.

The use of morphine.—Although this drug deserves its title as the "doctor's best friend and pain's worst enemy," it must be administered cautiously to patients with thoracic injury. The recently wounded patient who is admitted to a hospital, usually will have had one or two injections of morphine to ease his pain when first seen and during transportation. This dosage (the exact amount should be determined, if possible), coupled with the inadequate circulation associated with shock, is apt to show an accumulative effect during resuscitation and may depress the cough and respiratory apparatus the actuation of which one is attempting to achieve. The observations of Beecher *(9)* should be read by all who anticipate treating freshly wounded patients. Additional administration of morphine, if indicated, should be given intravenously in suitable doses to gain the response desired without prolonged effect.

"Stove-in" chest and sternal fractures.—Treatment during the resuscitative phase is aimed at "fixing" the collapsed chest wall in a stable position. If the injury is unilateral, this is best accomplished by wide adhesive strapping, beginning at the bottom and working up. The patient is directed to lie on the affected side and sand bags are used to maintain this "fixed" state. If the condition is bilateral, or if there is sternal separation or fracture, the chest wall may be suspended by towel-clip traction to the costal cartilages or to sternal screws that elevate and maintain their position from 2- to 4-pound traction over the pulley on an upright Balkan frame. Numerous ingenious measures for fixation have been described but most are not applicable at this stage of treatment. In most patients the use of the resuscitative measures outlined herein, plus simple fixation, strapping, and sand bagging will suffice. If it is necessary to transport a patient who is being treated by some form of traction, the apparatus may be incorporated in a plaster cast which is applied around the thorax from the level of the suprasternal notch to the lowest portion of the thoracic cage.

(9) Beecher, H. K.: Some controversial matters of anesthesia for thoracic surgery. J. Thoracic Surg. 10: 202-219, Dec. 1940.

Reduction in vital capacity.—The management of hemothorax, pneumothorax, or the two combined is the commonest problem confronting the admitting surgeon. It has been estimated that blood or air (usually both) will be present in the pleural space in about 70 percent of patients with injury to the thorax. A hemothorax must not be regarded as a simple hematoma but as a foreign body in a most vital space. The pleural cavity responds to this irritation by "weeping" serous fluid which increases the pleural mass.

The accepted treatment is removal of the fluid and air. When present the vital capacity of *both* lungs is markedly reduced. In the dyspneic patient with mediastinal shift, aspiration of the pleural contents is imperative. As much as 1,000 cc. of the bloody contents usually can be removed safely at one time if easily obtained. When the patient complains of "tightness in the chest," a good stopping point has been reached as this symptom indicates that too rapid restoration of the negative pressure has been accomplished. The "conservative" management of hemothorax is a vague term and may be interpreted as meaning anything from no treatment to occasional aspirations for relief of symptoms. An orderly plan of regular aspirations should be followed beginning within the first 24 hours after injury and continued daily until the pleural space is dry and the lung is completely re-expanded.

The question to be answered in this initial phase of treatment is, "Has the bleeding stopped?" If the injury is solely of lung parenchyma, the compression of the lung by the fluid within the pleural space, the elevation of the diaphragm, and the low pressure within the pulmonary arteries combine to limit the hemorrhage. More than 1,500 cc. of blood from parenchymal injury alone is unusual. Secondary hemorrhage from parenchymal injury is very rare; Bradford *(10)* found only 3 instances in 100 patients with hemothorax.

Bleeding from hilar vessels is usually fatal because the patient usually will die before receiving hospital care. Bleeding from the mammary or intercostal vessels is usually progressive. Besides the roentgenologic changes and the physical signs of the re-accumulation of blood within the pleural space, the following criteria have been used as a guide to denote continuous serious hemorrhage: (1) a blood pressure which fails to rise with apparent adequate transfusion of blood (up to 2,000 cc.) or which, having risen to normal levels, falls again; (2) re-accumulation of from 1,500 to 2,000 cc. of blood in the pleural space within 24 hours after an initial aspiration of a similar large amount; and (3) persistent severe anemia in spite of replacement of blood, as determined by serial hematocrit readings.

When the diagnosis of persistent serious hemorrhage has been made, surgical intervention in order to control the bleeding is the only reasonable method of treatment. An added advantage to surgical intervention

(10) Bradford, J. R.: On gunshot injuries of chest with especial reference to haemothorax. Brit. M. J. 2: 141-146, Aug. 4, 1917.

is the opportunity to remove all foreign material within the pleural space and to perform a decortication of the clot that has become adherent to both pleural surfaces, in particular to the visceral surface.

There is no evidence that early aspiration prolongs or brings about a recurrence of hemorrhage nor is there evidence that air replacement is helpful. In fact, evidence would condemn the procedure of air replacement because it is not necessary to arrest or prevent hemorrhage, it is desirable to evacuate air to restore pulmonary function by reexpansion of the lung, and should infection occur, there may be a total empyema if air is present, while there may be only a basilar empyema if there is a minimal amount of unexpanded lung.

THERAPY IN THE REPARATIVE PHASE

In this phase of therapy, a complete understanding of recognized surgical technics as applied to the thorax, the preoperative use of resuscitative measures to insure that the patient will experience the least possible operative risk, and an adequately planned and supervised postoperative regimen are necessary. Duval et al. *(11)* reported from World War I a series of 3,000 patients received in ambulances and evacuation hospitals with penetrating wounds of the chest. The mortality rate was 30 percent in this group. As this does not include deaths at advanced stations or death occurring later in base hospitals, a more accurate figure probably would be in excess of 50 percent. As contrasted to the above figure Nicholson and Scadding *(12)* reported a mortality rate of 4.27 percent in 1,639 patients with penetrating thoracic wounds in World War II. Johnson *(13)* reported a mortality rate of 7.4 percent in 308 similar cases.

Many factors have been responsible for this reduction of the mortality rate, not the least of which have been adequate primary treatment, early and rapid evacuation, more widespread familiarity with the significance of and the need for immediate correction of alterations in pulmonary physiology, the availability and early use of substances for blood replacement, the use of chemotherapeutic and antibiotic substances, and a more vigorous application of improved surgical technics.

Sucking wounds which have been occluded temporarily by sealed dressings or by rough approximation of the edges of the wound should be repaired with the same precautions as given an intrapleural operation. Control of pulmonary pressures by intratracheal intubation should be instituted even though the procedure be performed under local infiltration anesthesia. With this safeguard to guarantee an adequate airway, care may be taken to débride all devitalized tissues.

---

(11) Duval, P.; Bastianelli, R.; Gask, G. E.; and Turner, G. G.: Symposium on surgical treatment of gunshot wounds of chest. Surg., Gynec. & Obst. 28: 1-28, Jan. 1919.

(12) Nicholson, W. F., and Scadding, J. G.: Penetrating wounds of chest; review of 291 cases in Middle East. Lancet 1: 299-303, Mar. 4, 1944.

(13) Johnson, J.: Battle wounds of thoracic cavity. Ann. Surg. 123: 321-342, Mar. 1946.

The wound of entrance of the missile may be small and apparently insignificant in appearance or may be a huge jagged wound. The wound of exit may be larger and more ragged. The tissue between the two wounds is usually markedly disrupted because of the sudden release of the kinetic energy contained within the missile. The destruction of tissue depends directly on the velocity of the missile at the moment of impact and the density of the tissue through which it passes. A missile may pass through parenchymal tissue of the lung with comparatively little damage, whereas the same missile traveling with the same velocity would produce marked destruction should it strike a substance with greater density, such as bone, owing to the fact that destruction of tissue is commensurate with the rapidity with which the kinetic energy is dissipated. In addition to the original missile, the fragments of bone will act as secondary missiles and produce additional damage.

Many have pointed out that traumatic wounds of the cartilage require surgical excision to prevent serious infection. If there is parenchymal damage within the chest that requires extensive surgical treatment, the site of trauma may be enlarged if exposure obtained in this manner is adequate. It is, however, unwise to work at a disadvantage, and it is frequently more expedient to complete the airtight closure of the sucking wound and perform a secondary thoracotomy through a separate wound with resection of a rib. Débridement and suture or resection of the damaged lung, removal of foreign bodies and splinters of bone, repair of the diaphragm, evacuation of blood and clots, and irrigation of the pleural space may now be accomplished with maximal efficiency. Injury to a pulmonary vein makes mandatory the removal of the lobe or lobes it drains. Extensive hematoma of a lobe must be viewed with suspicion as to the future usefulness of that lobe. The lobe is vulnerable as a source of infection and the possibility of a potential traumatic arteriovenous fistula must be recognized.

The following points deserve attention: (1) the surgical closure of a sucking wound must be airtight; (2) if the defect of the chest wall involves a large loss of bony structure, the insertion of a muscle flap to close this defect should be performed at the initial operation; (3) because of elasticity, most authors believe that the parenchyma of the lung should be closed by interrupted sutures rather than by a single continuous suture; (4) positive pressure should be used to determine adequate expansion of the lung before closing; and (5) closed water-trap drainage or suction with mild negative pressure should be instituted to aid in re-expanding the underlying lung.

Continued bleeding.—If, by using the criteria as outlined under resuscitative measures for continued hemorrhage, it is decided that bleeding is progressive, thoracotomy should be performed. The source of the hemorrhage will usually be intercostal vessels, the azygos vein, the internal mammary artery, hilar vessels, the diaphragm or viscera immediately beneath, or from extensive pulmonary lacerations.

The management of hemothorax and its sequelas, empyema or fibrinous pleuritis, or both, is a major problem in each phase of treatment. Extensive tissue damage plus bleeding combine to form fibrin clots. Thus the three immediate harmful effects, blood loss, pleural irritation, and space occupancy in the chest, are manifest. For this reason, some authors have advocated early thoracotomy with evacuation of blood clot and fibrin. They believe that the simple removal of the foreign substance will produce a cessation of the bleeding by hastening re-expansion of the lung. The good results of repeated aspiration do not justify such radical surgical procedures in the acutely ill patient. Betts and Lees *(14)* have practiced irrigation of the pleural space through simple perforating wounds with apparently a reduction in the number of posttraumatic aspirations.

Injuries to the mammary and intercostal arteries may be: (1) false aneurysms with subpleural hematoma and infiltration with delayed secondary hemorrhage, or (2) those associated with intrapleural laceration and continued intrapleural hemorrhage. In the first type, isolation and ligation of the intercostal artery at points proximal and distal to the injury are needed for control of the hemorrhage, as arterial pressure may be exerted in both directions. If the bleeding is thought to be caused by injury to the internal mammary vessels, an anterior parasternal incision at the desired level will expose these vessels. Disarticulation of the costocartilages may be performed if the primary exposure is inadequate. Injury to the vessels of the second type will be discussed in section III (October issue) of this series. Open thoracotomy is necessary to correct bleeding from other sources.

Thoraco-abdominal injuries.—In combined thoraco-abdominal wounds, the wound in the chest should be explored first because intensive abdominal exploration is poorly tolerated by the patient with cardiorespiratory imbalance, and it may be possible to explore and repair the abdominal viscera through the diaphragm. Wounds of the superior surface of the liver are best repaired from the diaphragmatic side. The application of free muscle or fat grafts, suture, or packing may be necessary to control hemorrhage from this organ. Extensive laceration requires abdominal exploration as well with drainage in order that bile peritonitis may be avoided as well as possible. Although fibrin foam was available in only small quantities toward the end of the war, this substance is very useful.

Lacerations of the spleen through a rent in the left hemidiaphragm are satisfactorily managed from the thoracic approach. Enlargement of the diaphragmatic opening through its membranous portion and in a direction toward the esophageal hiatus will furnish adequate exposure for inspection and repair of the stomach or for resection of the spleen. By palpation through this opening the entire abdominal cavity includ-

(14) Betts, R. H., and Lees, W. M.: Military thoracic surgery in forward area. J. Thoracic Surg. 15: 44-63, Feb. 1946.

ing the pelvis may be explored manually but for obvious reasons this examination may prove to be inadequate. Because of the possibilities of multiple injuries to hollow viscera by concussion or by direct trauma from high-velocity missiles, a more complete visual examination through an abdominal incision is recommended. The diaphragm should be sutured edge to edge with interrupted silk sutures or slightly overlapped. If there has been loss of substance of the diaphragm, the phrenic nerve may be crushed as it courses over the pericardium, the posterior lateral attachment of the diaphragm detached, the central defect of the diaphragm closed, and the posterior lateral edge of the diaphragm reattached to the intercostal muscles at a higher level. On the right side, if a large defect is present, a similar procedure may be carried out or suture of the cut edges of the diaphragm to the capsule of the liver may serve as a temporary seal until the threat of infection is past. Then, if needed, a plastic repair with a fascial graft may be attempted.

Hemothorax and infected hemothorax.—Prior to World War II, despite the teachings of some observers, the accepted therapy as stated by Barrett *(15)* is indicated in the statement that "the mere presence of a hemothorax warrants neither operation nor aspiration." This now can be regarded as old fashioned for to neglect a hemothorax is to court trouble. Because the bloody effusion acts as a retained foreign body, a series of pathologic changes occur. The fluid is pocketed by fibrin partitions, and organization of the fibrin deposits on the pleural surfaces begins. This layer of organizing fibrin binds down the lung and prevents re-expansion so that the only manner in which the space originally occupied by the effusion can be healed is by contracture of the chest wall, elevation of the diaphragm, and retraction of the mediastinum. These deformities, which are the usual end result of the untreated hemothorax, produce all grades of disability from slight to crippling limitations of the cardiorespiratory function. The phenomenon that fibroblasts occur early in the investing layer of fibrin is the cardinal point in the pathologic changes that occur in hemothorax. Samson et al. *(16)* have given an excellent microscopic description of the "peel." The term "thickened pleura" is a misnomer. The density seen radiographically is the investing layer of clotted blood and fibrin, the serosal surface of which is loosely adherent to the pleura. Treatment by aspiration should start within 24 hours. A delay of 5 or 6 days means increased difficulty in evacuating the cavity. Air replacement should not be used. The patient should be given a sedative, and adequate local infiltration should be made. If daily aspirations are needed, care should be taken to cause as little pain as possible, as the cooperation of the patient is necessary. Aspiration should be high in the chest. Kent and Tebrock *(8)* have said that the lowest level of aspira-

(15) Barrett, N. R.: Haemothorax; notes and observations. Lancet 1: 103-106, Jan. 27, 1945.

(16) Samson, P. C.; Burford, T. H.: Brewer, L. A., III; and Burbank, B.: Management of war wounds of chest in base center; role of early pulmonary decortication. J. Thoracic Surg. 15: 1-30, Feb. 1946.

tion should be the ninth interspace in the posterior axillary line, the seventh interspace in the midaxillary line, and the fifth interspace if aspiration is anterior. Holman and Rogers (17) have expressed a preference for the second or third interspace anteriorly. The rationale for this concept is the fact that the diaphragm is frequently elevated in hemothorax and most of the fluid portion is in the upper parts. A 13- to 15- gage needle will be needed for some of the jellylike clots. Persistence and patience are the watchwords, for repeated aspirations should be made until the pleural space is dry, until re-expansion of the lung is complete, or until it is not possible to remove fluid even with a large-bore needle.

Decortication.—Although not a new operative procedure, decortication never was widely used until World War II. It is indicated in patients in whom there is at least 30 percent persistent compression of the lung, especially if the apex is compressed, in spite of repeated aspirations or for whatever cause, and in patients in whom primary aspiration has been unsuccessful.

The optimal time for decortication is from 3 to 5 weeks after injury. If performed less than 2 weeks after injury, the peel is thin and friable. The operation is tedious as the poorly defined membrane must be removed piecemeal or meticulously wiped from the pleural surfaces. When performed too late (from 10 to 14 weeks after injury) the fibrous union between the peel and pleura is often so firm that a proper cleavage plane cannot be established. The visceral pleura is frequently torn and the lung does not expand readily because of fibrous ingrowths along the septa. The operation itself should be performed under intratracheal anesthesia through a thoracotomy wound of the surgeon's choice.

The parietal pleura and thickened peel is incised so that an opening is made into the "hollow" of the hemothorax. The liquefied contents, clots, pus, and debris are evacuated. The peel covering the visceral pleura is incised and by careful dissection the proper cleavage plane between these two structures is entered. Finding this line of cleavage is essential to the success of the operation. Two general methods are used: (1) the visceral peel may be "crosshatched" and positive pressure applied to the lung by the anesthetist thus expanding the crosshatched segments and causing their edges to curl at their junction with the visceral pleura so that the patches can be dissected away bluntly; and (2) a single incision down to the visceral pleura may be made and by the use of gauze "pushers" or dissectors, the peel may be freed in one piece.

Regardless of the method used to initiate the operation, the salient feature to be accomplished is the complete release of the incarcerated

(17) Holman, E., and Rogers, W. L.: Laboratory course in thoracic surgery; exercises in performance of surgical procedures on thorax with discussion of their clinical applications. Arch. Surg. 49: 373-387, Dec. 1944.

960522 O - 51 - 3

lung from the enveloping fibrinous membrane in order that complete re-expansion may occur. Particular attention should be directed to the costophrenic sulcus and the fissures of the lung, as fixation at these sites prevents total expansion of the lung. The most difficult portion to free is the apex of the upper lobe, and the dissection also must be carried well down to the mediastinal hilar attachments.

The viscemal pleura beneath the peel is usually of normal consistency and is expansible when decortication is performed at the optimal time. Areas of atelectatic lung may be gently "teased" by the surgeon's hand as positive pressure through the intratracheal tube is gradually increased. Ballooning up of compressed lung to fill the thoracic cage completely so as to insure a satisfactory functional result is ample reward for exacting and meticulous dissection. Unless unusual adherence of the peel to the visceral pleura has occurred, tearing of or bleeding from the pleural surfaces is minimal. Closed water drainage with gentle negative pressure should follow decortication. The success of these methods in the reparative phase is attested to by the excellent mortality and morbidity figures that fill the literature.

Electromyography

Arthur E. White, *Colonel, MC, U. S. A.* (1)
James D. Amos, *Major, MC, U. S. A.* (1)

INCREASING clinical interest in electromyography has developed during the past two decades. Electromyography is a direct application of electrophysiology to practical medicine (2). It has emerged as a diagnostic method with a high degree of accuracy and widespread clinical application (3). Earlier workers were hampered by inadequate electric potential recording devices (4), but the advent of the oscilloscope and electronic sound system now place the electromyograph (fig. 1) alongside the electrocardiograph, the x-ray and other accepted diagnostic instruments.

The card over the oscilloscope screen in figure 1 permits incorporating pertinent data on the same film which contains the "wave pattern." This assures a permanent photographic record for future reference (especially in medicolegal cases). This card was developed by the authors. The drawer at the bottom of the machine contains the tape recorder for the playback of both the original auditory and visual muscle exploration.

Electromyography should be used as an aid to diagnosis only after full and careful clinical evaluation. Without a clear clinical picture in his mind, the physician may often find machines more misleading than useful in any branch of medicine (5). In addition, electromyography should be preceded by muscle testing with a suitable rectangular wave (electrodiagnostic) stimulator because a combination of the procedures gives a much more complete picture than either alone (2). The use of electromyography presupposes thorough training in the interpretation of data obtained from it otherwise confusion would result when any but the most elementary action potentials are elicited. Jasper and Cone

(1) Letterman Army Hospital, San Francisco, Calif.

(2) Bauwens, P.: Electromyography. Proc. Royal Soc. Med. 41: 291-298, May 1948; Brit. J. Phys. Med. 11: 130-136, Sept.-Oct. 1948.

(3) Shea, P. A.; Woods, W. W.; and Werden, D. H.: Electromyography in diagnosis of root compression syndrome. Arch. Neurol. & Psychiat. 64: 93-104, July 1950.

(4) Liebesny, P.; Fleck, H.; and Frank, S.: Contributions to clinical electromyography; with a case report on Guillain-Barre syndrome. Am. Pract. 2: 396-399, Feb. 1948.

(5) Sargent, F.: Value of electromyography in clinical neurology. Lancet 1: 937-943, May 20, 1950.

(6) found that specially trained physicians using this instrument could diagnose nerve lesions with an accuracy of at least 90 percent, as judged by comparison with operative findings and clinical follow-up studies.

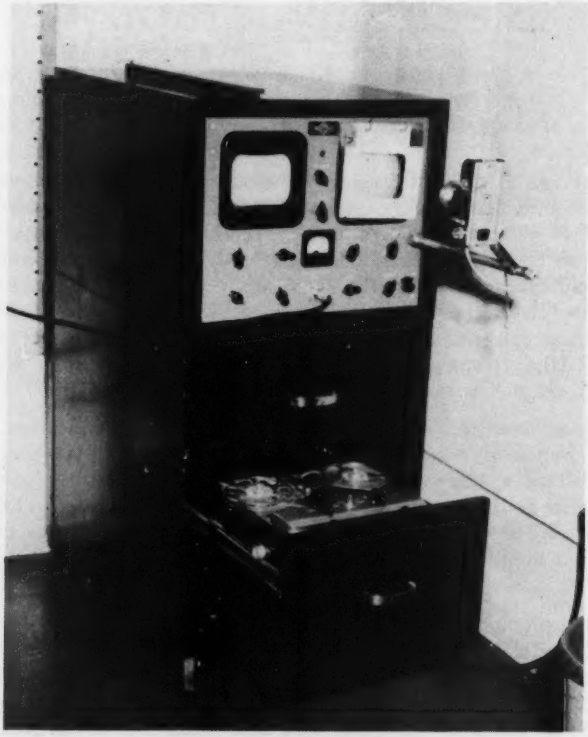


Figure 1.—The electromyograph.

In order to record and measure muscle voltages accurately, it is necessary to elicit them from the muscle by means of an electrode which is either in contact with or near the muscle fibers. Monopolar electrodes of the lacquered needle type are highly satisfactory (6). A fine steel needle (fig. 2), insulated with vinylite except at the tip, is used as the exploring electrode. It is inserted directly into the muscle being examined. Its only disadvantage is the pain caused by insertion of the needle through the skin, and this is minimal. The earlier workers in electromyography used percutaneous electrodes. Although these are

(6) Jasper, H. H., and Cone, W. V.: Electromyography in peripheral nerve lesions. Trans. Am. Neurol. Assoc. 71: 48-52, 1946.

still being used in gross muscle studies (7, 8), they have the disadvantage of not detecting the minute voltages effected by fibrillation.

The electric potentials present in innervated and denervated muscle tissue are of minute microvoltages. These potentials must be amplified and projected in both a visual and auditory form. The oscilloscope and speaker attachment permit photographic records to be taken, or a tape of both the auditory and visual impulses may be recorded. The advantage of the tape recording is that a record of a complete muscle exploration may be preserved and "played back" through the speaker and oscilloscope of the electromyograph at any time.

Figure 2.—Monopolar needle electrode.

MUSCLE POTENTIALS

An understanding of the types of potentials seen in normal, denervated, and partially denervated or re-innervated muscle is necessary before the application of electromyography to clinical medicine can be discussed. In his description of electromotive forces, Bauwens (9) stated that living tissue is the seat of electric polorization phenomena, and that the polorization varies according to the state of the tissue. In the case of nerve and muscle fibers, the polorization exists at rest, and is momentarily abolished during activity. This depolorization produces electric disturbances which are called "action potentials."

When a muscle is examined with a needle electrode certain phenomena occur (fig. 3).

Insertion potentials (fig. 3a) resemble normal motor unit action potentials but can be distinguished from them by the mechanical method of their production (10). They consist of short outbursts of repetitive action potentials, usually diphasic in character, which are of lower amplitude and shorter duration than those of ordinary motor unit action potentials. The duration of insertion potentials was found to be 4 milli-

(7) Hansson, K. G.: Electromyographic studies in poliomyelitis. Arch. Phys. Therapy 23: 261-266, May 1942.

(8) Dawson, G. D., and Scott, J. W.: Recording of nerve action potentials through skin in man, J. Neurol., Neurosurg. & Psychiat. 12: 259-267, Nov. 1949.

(9) Bauwens, P.: Electromyography in clinical medicine. Brit. J. Phys. Med. 10: 75-78, May-June 1947.

(10) Weddell, G.; Feinstein, B.; and Pattle, R. E.: Electrical activity of voluntary muscle in man under normal and pathological conditions. Brain 67: 178-251, Sept. 1944.

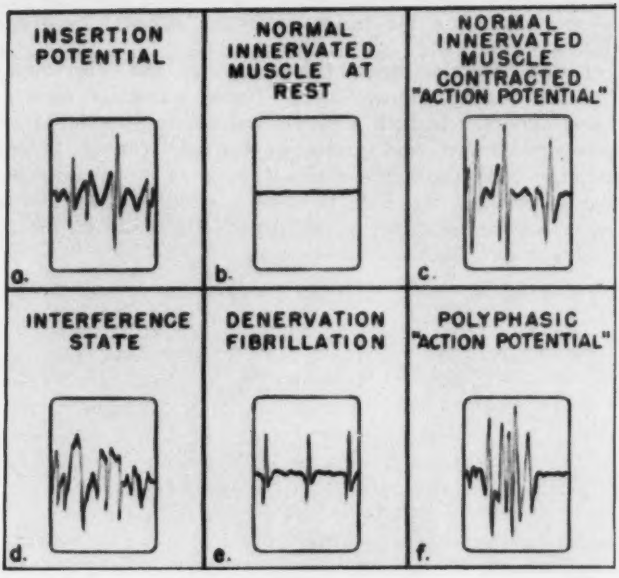


Figure 3.—The muscular action potentials as shown on the electromyogram.

seconds in the biceps muscle *(11)* with a frequency of about 200 per second. They usually occur only during the actual movements of the needle but may last for a few seconds. This type of potential produces a "knocking" sound in the loud speaker.

Normal innervated muscle at rest (fig. 3b).—After the needle electrode has been placed in position and the insertion potentials have died out, there is complete electrical silence if the muscle has normal motor nerve innervation and is at rest *(12-14)*.

Normal innervated muscle when voluntarily contracted (fig. 3c) gives rise to repeated action potentials. They vary in frequency from 5 to 50 per second *(11,15)*, in amplitude from 100 to 2,000 microvolts, and in duration from 5 to 10 milliseconds. These variables depend on the ten-

(11) Kugelberg, E., and Petersen, I.: Insertion activity in electromyography with notes on denervated muscle response to constant current. J. Neurol., Neurosurg. & Psychiat. 12: 268-273, Nov. 1949.

(12) Adrian, E. D., and Bronk, D. W.: Discharge of impulses in motor fibres; frequency of discharge in reflex and voluntary contraction. J. Physiol. 67: 119-151, Mar. 1929.

(13) Golseth, J. G., and Huddleston, O. L.: Electromyographic diagnosis of lower motor neuron disease. Arch. Phys. Med. 30: 495-500, Aug. 1949.

(14) Hoefer, P. F. A., and Putnam, T. J.: Action potentials of muscles in normal subjects. Arch. Neurol. & Psychiat. 42: 201-218, Aug. 1939.

(15) Weddell, G.; Feinstein, B.; and Pattle, R. E.: Clinical application of electromyography. Lancet 1: 236-239, Feb. 20, 1943.

sion of the muscle. The form of these waves is usually diphasic but may be monophasic or triphasic. A low-pitched "thumping" sound caused by the long duration is heard on the speaker.

Normal innervated muscle when voluntarily contracted to its fullest capacity (fig. 3d) exhibits what is known as "interference state." The intensity of contraction increases with the increasing number of active motor units caused by increase of the impulse frequency from the anterior horn cells (5). The action potentials of neighboring motor units, therefore, interfere with each other.

Denervated muscle produces certain changes on the oscilloscope and from the speaker. If an electromyographic study is made within the first 16 to 21 days of denervation, only insertion potentials are picked up; then there is electrical silence. After the first 16 to 21 days the insertion potentials are noted followed by fibrillation action potentials, otherwise known as denervation fibrillations (fig. 3e). When seen on the oscilloscope they are a series of repetitive spikes, mono-, di-, and occasionally triphasic, from 1 to 2 milliseconds in duration, with amplitudes of from 10 to 100 microvolts, and a frequency of from 2 to 50 per second. The repetitive nature is easily seen and may be timed. Fibrillations of two or more different amplitudes may be seen to follow in a regular rhythm and repeat themselves in that same rhythm; or two or more repetitive fibrillations may occur, each maintaining a separate rhythm and a different amplitude. These potentials are heard on the speaker as short clicks much higher pitched than the normal action potentials. Fibrillation, besides denoting denervation, tells us that the muscle fibers are still alive. For a muscle in which successive electromyograms show a gradual decrease in number and amplitude of fibrillations, one can give a poor prognosis. When a muscle is both denervated and electrically silent, it has undergone fibrosis (9).

Muscles being re-innervated and muscles being affected by demyelinating disease give another type of wave. This is important in differentiating neurologic conditions with the electromyograph and was first described by Weddell and his co-workers (15) as "nascent" motor unit potentials. These complex potentials are now called "polyphasic' action potentials" (fig. 3f). These complex or polyphasic action potentials are seen in muscles which are being re-innervated and in muscles affected by demyelinating disease, They are also noted in degenerative diseases such as amyotrophic lateral sclerosis, and progressive muscular atrophy (13).

Complex potentials are seen in re-innervating muscle long before any voluntary motion is possible (16). They are polyphasic waves having as many as 12 or more spikes, though early in re-innervation they may have only 2 or 3 spikes. Their amplitude is lower and their duration is shorter than that of normal motor unit potentials. This lower amplitude

(16) Berry, C. M.; Grundfest, H.; and Hinsey, J. C.: Electrical activity of regenerating nerves in cat. J. Neurophysiol 7: 103-115, Mar. 1944.

results from the fact that motor units of recently innervated muscles do not contain as many muscle fibers as normal (*10*). This also accounts for the greater variation in amplitude and duration of these polyphasic forms. The polyphasicity may be caused by the differences in the conduction time of the various muscle fibers in a motor unit (*17*). Great variations have been found in the diameters of the preterminal axon fibers of re-innervated muscle. The differences in conduction time caused by variation produces asyncronous muscle fiber contractions in a motor unit (*10*). On the loud speaker these complex potentials are heard as harsh, low-pitched thumps.

ELECTROMYOGRAPHY IN NEUROLOGIC CONDITIONS

Peripheral nerve injuries.—The principal diagnostic points in peripheral nerve injuries (*6,10,15,17-19*) are:

1. Three or more weeks after injury or paralysis if on attempted movement of the muscle, sustained motor unit activity is seen on the oscilloscope (even in the absence of perceptible movement) and no fibrillations are present then it is correct to say "no axons have been severed." The paralysis is a transient block.

2. Fibrillation potentials in the absence of motor unit action potentials indicate complete lower motor neuron denervation of the muscle. These fibrillation potentials are an extremely valuable diagnostic sign in that fibrillations which occur in denervated muscles are the result of sensitization of the muscle fibers, by neural atrophy, to the small amounts of acetylcholine in the circulation.

3. A mixture of fibrillation and simple motor unit action potentials indicates a partial nerve interruption or incomplete regeneration. In case of doubt as to the presence of fibrillation, a nerve block can be performed and the motor unit activity excluded.

4. A mixture of fibrillation and complex motor unit action potentials indicates that muscle re-innervation has begun. The rate of nerve regeneration in man is about 2.5 mm. per day. The earliest sign of re-innervation is the appearance of the complex potentials. This is shortly followed by a decrease in the fibrillary activity as more muscle fibers become innervated.

5. When no electric activity can be obtained from a muscle more than a few weeks after a nerve injury, severe morphologic changes (fibrosis) may be assumed to have taken place.

(*17*) Jasper, H., and Ballem, G.: Unipolar electromyograms of normal and denervated human muscle. J. Neurophysiol. 12: 231-244, July 1949.

(*18*) Kugelberg, E.: Electromyograms in muscular disorders. J. Neurol., Neurosurg. & Psychiat. 10: 122-133, Aug. 1947.

(*19*) Golseth, J. G., and Fizzell, J. A.: Electromyographic studies on cats after section and suture of sciatic nerve. Am. J. Physiol. 150: 558-567, Oct. 1949.

Poliomyelitis.—Recent observations *(20-23)* have shown spontaneous discharges in anterior poliomyelitis to be a striking feature, especially in the convalescent stage when they are a sign of improvement of muscular function. The completely paralyzed muscle is electrically silent except for fibrillations which develop from 16 to 21 days after the onset of poliomyelitis. Muscular spasm is absent during the time of development of paralysis in acute anterior poliomyelitis *(24)*. There is an increase in irritability to stretching of muscles during the acute stage without any correlation to spasm, tenderness, or pain on stretching. The pattern of electric discharges produced by stretching resembles in appearance that obtained from muscles in a state of tonic contracture or spasm secondary to fracture of an extremity *(21)*. Hansson and his collaborators *(7)* found a decrease in the amplitude and number of action potentials in muscles weakened by poliomyelitis. They also found this decrease to be almost proportional to the decrease in muscle power. On this data they offered a method of grading muscle strength with the electromyograph.

Huddleston and Golseth *(20)* found that there is a definite relation ship between the finding of denervation fibrillations in a muscle paralyzed or weakened by poliomyelitis and its recovery. Fibrillation potentials are found in greater numbers in muscles of low strength than in those of greater strength. Conversely, motor unit voltages are greater in stronger than in weaker muscles. Complete functional recovery has not been observed in muscles which exhibited fibrillations throughout their lengths, from 21 to 40 days after the onset of poliomyelitis. They concluded that the data obtained electromyographically from paralyzed and paretic muscles is of prognostic and diagnostic significance.

Spinal cord lesions including herniated nucleus pulposis.—The level of lesions along the spinal cord have always been of importance to the neurosurgeon. Much interest has been evidenced lately in the localization of these lesions by the electromyograph *(4, 22, 25-27)*. This method developed directly from the fact that compression or irritation of a

(20) Huddleston, O. L., and Golseth, J. G.: Electromyographic studies of paralyzed muscles in anterior poliomyelitis. Arch. Phys. Med. 29: 92-98, Feb. 1948.

(21) Watkins, A. L.; Brazier, M. A. B.; and Schwab, R. S.: Concepts of muscle dysfunction in poliomyelitis based on electromyographic studies. J. A. M. A. 123: 188-192, Sept. 25, 1944.

(22) Watkins, A. L.: Electromyographic studies in poliomyelitis. Journal Lancet 64: 233-236, July 1944.

(23) Brazier, M. A. B.; Watkins, A. L.; and Schwab, R. S.: Electromyographic studies of muscle dysfunction in infectious polyneuritis and poliomyelitis. New England J. Med. 230: 185-189, Feb. 17, 1944.

(24) Pollock, L. J.; Boshes, B. and Finkelman, I.: Absence of spasm during onset of paralysis in acute anterior poliomyelitis. Arch. Neurol. & Psychiat. 61: 288, 1949.

(25) Elliot, F. A.; Tender muscles in sciatica; electromyographic studies. Lancet 1: 47-49, Jan. 8, 1944.

(26) Hoefer, P. F. A., and Guttman, S. A.: Electromyography as method for determination of level of lesions in spinal cord. Arch. Neurol. & Psychiat. 51: 415-422, May 1944.

nerve root sets up fibrillation potentials which can be elicited in the corresponding muscles served by that nerve.

In anterior horn cell disease the voltage of the motor unit potentials is almost invariably higher than that in cases of root compression. In addition, the voltage varies in a completely unpredictable way *(27)*. Because anterior horn cell diseases such as progressive muscular atrophy and amyotrophic lateral sclerosis frequently have only localized muscle atrophy, it is of value to make an electromyographic survey of all patients with muscle atrophy if the cause is not clear, because in this manner a general diffuse degenerative disease may be discovered.

When a series of electromyograms taken from a patient with a herniated disk are arranged according to segmental nerve supply, it is a simple matter to determine the common nerve root of those muscles which show fibrillary activity and thus localize the lesion. This method does not specifically indicate a disk lesion, but simply irritation of one of the nerve roots *(22)*. This electromyographic method was found to be accurate in localizing the exact nerve roots involved in 68 of 75 patients *(4)* in one series, in 17 of 24 *(26)* in another and in 10 of 10 *(27)* in a third series.

PRIMARY MUSCULAR DISORDERS

Although little difference is noted electromyographically between muscular dystrophies of the proximal and distal types, the electromyogram in patients with primary muscular disorders as a whole has certain distinctive characteristics when compared with the normal electromyogram or with that observed in lower motor neuron disease. Kugelberg *(28)* has pointed out certain characteristics of muscular dystrophy to be uniformly present in both proximal and distal types. The distribution curve for the duration of the action potentials is shifted toward the short side. The number of potentials with a duration of 1 to 3 milliseconds is increased. The form of the action potentials is changed in that a pathologic increase of polyphasic potentials which have a shorter duration than the action potential in the normal muscle is observed. A decrease in the amplitude is also evident. A decrease in number of action potentials occurs only in the later stages of the disease. Most of these electromyographic changes can be explained by the reduction in the number of muscle fibers in each motor unit. Thus, as the number of muscle fibers is lessened, a small number contract asynchronously, and the duration of the potential is lessened. This would also cause the increase in polycyclic potentials because a reduction in the number of muscle fibers would take out some of the intermediate phases, thus causing an apparent splitting of the potentials.

---

(27) Brazier, M. A. B.; Watkins, A. L.; and Michelsen, J. J.: Electromyography in differential diagnosis of ruptured cervical disk. Arch. Neurol. & Psychiat. 56: 651-658, Dec. 1946.

(28) Kugelberg, E.: Electromyography in muscular dystrophies. J. Neurol., Neurosurg. & Psychiat. 12: 129-136, 1949.

When this progresses, as in advanced cases with few muscle fibers to each active motor unit, the potentials appear as single oscillations. These single action potentials are caused either by the activity of a single fiber or by the more or less synchronous activity of a few fibers in the same motor unit (29).

This affords a simple aid to differential diagnosis of the chronic lower motor neuron diseases and the dystrophies because the former will show any combination of the following: spontaneous fibrillation, more marked insertion potentials, greater duration and amplitude of the action potentials, polyphasic potentials of longer duration than the action potentials in a normal muscle, and finally, the number of spikes is reduced in proportion to the diminution of the muscular force. These differences result from the fact that neurogenic disorders affect nerve fibers, and thus whole motor units instead of primarily single muscle fibers and parts of units (28). Dystrophia myotonica gives essentially the same electromyographic findings as progressive muscular dystrophy (28, 29).

Myasthenia gravis also gives findings typical of those for muscular dystrophy. The electromyogram, in addition, shows the fatigue characteristic of the disease (30) and a decrease in spike amplitude on continued contraction (31). This is of value in following the progress of the disease.

Paralysis agitans cause rhythmic bursts of action potentials on the oscilloscope. If two antagonistic muscles are tested simultaneously these bursts may be seen to occur alternately in each muscle. These bursts of potentials occur at the rate of about six per second (32).

There are many other uses for electromyography such as kinesiologic studies of the upper extremity, the shoulder joint, the adductors of the hip, and the trapezius (33-37). It is also of value in differentiating between organic and functional paralysis.

---

(29) Buchthal, F., and Clemmesen, S.: On differentiation of muscle atrophy by electromyography. Acta psychiat et neurol. 16: 143-181, 1941.

(30) Watkins, A. L.: Electromyography in orthopaedics. J. Bone Surg. 31: 822-830, Oct. 1949.

(31) Lindsley, D. B.: Electrical activity of human motor units during voluntary contraction. Am. J. Physiol. 114: 90-99, Dec. 1935.

(32) Schwab, R. S., and Cobb, S.: Simultaneous electromyograms and electroencephalograms in paralysis agitans. J. Neurophysiol. 2: 36-41, Jan. 1939.

(33) Bierman, W., and Yamshon, L. J.: Electromyography in kinesiologic evaluations. Arch. Phys. Med. 29: 206-211, Apr. 1948.

(34) Inman, V. T.; Saunders, J. B. deC. M.; and Abbott, L. C.: Observations on function of the shoulder joint. J. Bone & Joint Surg. 26: 1-30, Jan. 1944.

(35) Inman, V. T.: Functional aspects of abductor muscles of hip. J. Bone & Joint Surg. 29: 607-619, July 1947.

(36) Yamshon, L. J., and Bierman, W.: Kinesiologic electromyography; trapezius. Arch. Phys. Med. 29: 647-651. Oct. 1948.

(37) Scherb, R., and Arienti, A.: Ist die Myokinesigraphie als Untersuchungsmethode objektiv zuverlässig? Schweig. med. Wchnschr. 75: 1077-1079, Dec. 8, 1945.

SUMMARY

Electromyography has become an accepted clinical diagnostic procedure of high accuracy. The electromyograph, using the monopolar needle electrode, permits excellent visual and auditory amplifications of muscle action potentials. The visual impulses seen on the oscilloscope may be photographed and both the visual and auditory amplifications may be recorded on tape for playback at any time. Electromyography is of value in detecting peripheral nerve injury, root compression syndrome, poliomyelitis, spinal cord lesions, primary muscular disorders, and differentiating organic and functional paralysis. The electromyograph may be used to determine the type of paralysis which is present, whether it is of a muscular disease, a lower motor neuron disease, or a peripheral nerve lesion.

Treatment of Frostbite of Toes

John B. Irwin, *Lieutenant, junior grade, MC, U. S. N. R.*
Herbert Schultz, *Sergeant, U. S. A.*

THE project here reported was undertaken at the rear of the third battalion of the Fifteenth Infantry Regiment in Korea. A squad tent was made available for hospitalization of all the patients with frostbite in this battalion. One sergeant of the Medical Service did the daily dressings, kept the records and supervised the patients. The physician visited the patients every 2 or 3 days. The patients remained on the morning report of the battalion. The purposes of the undertaking were to: (1) maintain battalion strength by not evacuating personnel thus losing them through their subsequent assignment to other units; (2) economize on transportation and save the time required for evacuation and reassignment; (3) discourage the suspected self-infliction of frostbite by those desiring evacuation to Japan; and (4) investigate rapid and practical methods of treating frostbite.

Numbness, pain and hyperhydrosis were not in themselves an indication for hospitalization or treatment according to our standards. Only those with blistering were hospitalized. For convenience the lesions were classified into three grades. In Grade I the blister extends down to, but does not include the stratum germinativum. In Grade II the blister extends down through the stratum germinativum and the skin pattern is lost. In Grade III the blistering and necrosis extend through the dermis and involve the fatty tissues.

The routine treatment schedule established was as follows: (1) the feet were thoroughly washed with soap and lukewarm water; (2) the toes were painted with merthiolate; (3) the blistered and necrotic tissues were completely excised; (4) nails were clipped short or completely removed if the blister extended under the nail bed (no pain was encountered in this procedure because of the anesthesia present in frostbitten toes); (5) zinc oxide ointment was applied to all lesions; (6) zinc oxide ointment with 3,000 units of procaine penicillin per cc. was applied if there was infection because in addition to its antiseptic action it afforded mild anesthesia to some painful toes (ointment with or without procaine penicillin usually relieved almost all pain and discomfort); (7) a plain gauze dressing was applied to each affected toe, using sterile technic insofar as limited supplies and facilities permitted; (8) if the lesion was grade 2, 3 or infected, 300,000 units of

procaine penicillin were given parenterally each day; and (9) all patients were allowed to walk at least to meals and the latrine. This reduced the nursing care required for each patient to a minimum, maintained good morale and probably aided circulation.

The daily care consisted of: (1) redressing; (2) reapplication of ointment; (3) further excision of necrotic tissues as necessary; (4) giving aspirin to relieve the aching pain which almost always appeared in the toe when it started to heal; and (5) on the last 3 or 4 days of hospitalization, patients were sent on graded walks up to 3 or 4 miles in order to recondition them for duty. Also at this time they were put on short periods of guard duty to aid in the local security.

Many patients presented themselves shortly after the appearance of a blister, but others did not come until the blister was old, dried out, hard, purple, and infected. The early treatment of these lesions halts the deeper extension of the necrotizing process. Marked improvement could be seen in the tissues after 1 or 2 days of treatment.

The only complication encountered was infection in the local necrotic tissues with almost complete absence of cellulitis. This was evidenced by a seropurulent exudate frequently found in the older lesions when initial treatment was delayed. Infection occurred frequently in the Grade II and III lesions which initially were apparently sterile. This was probably caused by failure of sterile technic resulting from the limited supply of sterile dressings. The infection was mild and usually well controlled by procaine penicillin given parenterally and topically and daily lukewarm magnesium sulfate soaks.

The results obtained from the above method of treatment are shown in table 1. The occasional long periods in the hospital in Grade I patients were the result of infection which slowed the healing process. None of the patients regressed or failed to improve with the prescribed method of treatment. The end point of treatment was a well epithelized surface which was usually dry and pink, or had a small crust. Toes frequently were still somewhat numb or painful at the time of discharge.

TABLE 1.—*Comparison of patients with three grades of frostbite*

	Grade		
	I (12 patients)	II (4 patients)	III (4 patients)
Average number of days:			
From frostbite to appearance of blister	3.7	2.3	3.3
Range	(1-7)	(2-3)	(2-4)
From frostbite to hospitalization	11.0	10.5	13.8
Range	(2-19)	(4-28)	(7-28)
In hospital	10.0	26.0	44.0
Range	(1-16)	(17-35)	(32-51)

The success of treatment in the rear hospital encouraged an attempt to treat frostbite while our infantrymen were carrying on their full duties in combat. Eleven such patients (8 Grade I and 3 Grade II) were so treated. The routine treatment schedule was followed as closely as possible. Of these patients, the nail was removed from the second toe of one man and from the great toe of another man. An attempt was made to change the dressings daily, but the tactical and topographic distribution of our troops occasionally necessitated an interval of 2 or 3 days between treatments. The change of dressings on the early morning sick call left each man available for full duty for the remainder of the day. There was a minimum of complaint of discomfort, and there was no disability or interference with the performance of duty. All lesions healed satisfactorily, though at a rate somewhat slower than that of those treated in the hospital. All patients were carefully instructed in foot care and supplied with adequate footwear. Each patient was questioned as to what he considered the most important factor in the causation of his frostbite. The results are shown in table 2.

TABLE 2.—*Factors to which patients attributed frostbite*

Grade	Long vehicle ride	Guard duty	Inadequate equipment	Combat
I	2	6	3	8
II	1	2	3	1
III	0	2	2	0

Unofficial reports indicate that patients with frostbite of equal severity in frostbite treatment centers in Japan have averaged about 45 days lost from duty. Our 20 hospitalized patients averaged 20 days in the hospital, indicating a saving of 500 man-days of front line duty. Similar calculations indicate a saving of over 400 man-days with the 11 patients treated while on full combat duty.

CONCLUSIONS

The ultimate strength and personnel of this battalion was not altered by frostbite. The minimum amount of time was lost from duty with no loss of time in transportation or in replacement depots. Self-infliction of frostbite for the purpose of evacuation was discouraged. A rapid, practical method of treating frostbite was established.

ARTICLES BY PERSONNEL OF THE MEDICAL SERVICES OF THE ARMED FORCES PUBLISHED IN OTHER JOURNALS

Brown, R. B., Capt., MC, U. S. N., and Ross, D., Commander, MC, U. S. N. R.: Congenital abnormalities of intestinal rotation and mesenteric attachment—a cause of intestinal obstruction in the adult. Ann. Surg. 134: 88-98, July 1951.

Cook, W. R., Col., MC, U. S. A., and Van Anken, H. A., Col., MC, U. S. A.: Nitrogen balance studies in Laennec's cirrhosis of the liver. Ann. Int. Med. 34: 1404-1415, June 1951.

Danyo, A., Lt. Comdr., NC, U. S. N.: Plasma clot technic for nerve repairs. Am. J. Nursing, p. 123, Feb. 1951.

Garrett, J. F., and Myers, J. S., First Lt., MSC, A. U. S.: Clinical psychology in the rehabilitation process. J. Rehabilitation, March-April 1951.

Graettinger, J. S., Lt., MC, U. S. N.; Packard, J. M., Lt., MC, U. S. N.; and Graybiel, A., Capt., MC, U. S. N.: New method of equating and presenting bipolar and unipolar extremity leads of the electrocardiogram. Am. J. Med. 11: 3-25, July 1951.

Jensen, M. N., Col., U. S. A. F. (MC): Multiple polyposis of small and large intestines, with multiple intussusception. Surgery 2: 772-776, May 1951.

Palmer, H. B., Lt. Col., U. S. A. F. (DC); Overstreet, S.; and Sacks, M.: Evaluation of various technics for reducing decalcification of enamel. Part I. In extracted, erupted, noncarious third molar teeth. J. Dent. Research 30: 75-81, Feb. 1951.

Banthine in the Treatment of Duodenal Ulcer[1]

Morgan M. Meyer, *Lieutenant, junior grade, MC, U. S. N. R.*
Julian A. Jarman, *Colonel, U. S. A. F. (MC)*

IN DISCUSSING any new medication for peptic ulcer, it is always important to bear in mind the pathophysiology of the disease itself. High gastric acidity is present in most patients with duodenal ulcer, and usually there is considerable hypersecretion and and hypermotility of the stomach. The actual cause of this disease has not been definitely proved, but in most of these patients there is an emotional factor which often produces an increased vagotonia with its consequent stimulation of gastric secretion and gastrointestinal motility.

Banthine is a quaternary amine which is readily soluble in ordinary solvents and in gastric and intestinal secretions. Its chemical name is beta-diethylaminoethyl xanthene-9-carboxylate methobromide. It is anticholinergic and provides autonomic ganglion blockage, principally affecting the parasympathetic system (2). It's action is similar to that of atropine. It inhibits the depressor action of acetylcholine, and electrical stimulation of the vagus in animals. It inhibits salivation and causes mydriasis. It manifests a double action on the parasympathetic system in that it affects the parasympathetic postganglionic nerve endings by blocking acetylcholine at that point, as well as at the ganglion level, which affects both sympathetic and parasympathetic nerve endings. It does not act on the postganglionic endings of the sympathetic system because their affectors liberate sympathin rather than acetylcholine. In toxic doses it has been noted to have a curare-like action on muscle affectors.

The toxicology of banthine is quite limited because the toxicity is very low, and the therapeutic index is good. No acute, subacute, or chronic toxicity has been noted in experiments on mice and rats,

---

(1) Presented at Monthly Staff Meeting, U. S. Air Force Hospital, Sheppard Air Force Base, Tex., January 1951.

(2) Brown, C. H., and Collins, E. N.: Use of banthine in treatment of duodenal ulcer; preliminary report. Cleveland Clin. Quart. 17: 234-241, Oct. 1950.

960522 O - 51 - 4

including microscopic tissue examination. No truly toxic manifestations in man have been reported. The side effects of banthine are believed to be important and provide a good means of regulating the dosage of the drug in man. The predominant side effect in man as reported by Grimson et al. *(3)*, as well as in our series, is dryness of the mouth and throat. Probably the second most common side effect is mydriasis. Rarer side effects are constipation, hoarseness, decreased perspiration, and in the older age group with prostatic hypertrophy, urinary retention. Tachycardia has been noted in rare instances, and occasionally has necessitated discontinuance of the drug. Impotence was reported in one patient. Most of these side effects correct themselves after 2 or 3 days, with continued medication at the same dosage level or on a slight reduction in the dosage. In our series we have not been forced to discontinue the drug for any of the above side effects.

The effects of banthine on the cardiovascular system in man include occasional slight rises in pulse and blood pressure, and a decrease in the skin temperature gradient from the umbilicus to the foot. No postural hypotension has been noted, and only rarely in patients with an apparent sensitivity does a true tachycardia develop. The effects on the gastrointestinal system include a marked decrease in gastric motility as studied by balloon tests, barium meal, and fluoroscopic studies. This effect is much more marked than with atropine. The drug effects a decrease in the volume, a rise in the pH, and an associated decrease in the amount of free and total acids in the gastric secretion *(4)*. This decrease in acidity and volume of secretions is definitely shown in the literature and is confirmed by our clinical studies. The decrease in the volume of the secretion seems to be more apparent than that of the acidity. The drug markedly decreases the propulsive activity of the small intestine *(5)*. The colonic activity as studied by balloon tests is decreased and the normally powerful parasympathetic stimulating effect of urecholine is inhibited. The gastrocolic reflex is also inhibited by banthine, but is little affected by atropine.

Table 1 summarizes the information concerning our patients with proved duodenal ulcer. They all had either a deformed bulb or evidence of an active crater at the time of study, and all were symptomatic. The first 4 had severe hemorrhage requiring from 3 to 5 pints of blood to restore adequate blood volume and to prevent circulatory collapse; all responded favorably. The next 4 were treated with banthine in the first few months after operation for perforated duodenal ulcer or for recurrence of ulcer with the history of an old perforation. The third

---

(3) Grimson, K. S.; Lyons, C. K.; and Reeves, R. J.: Clinical trial of banthine in 100 patients with peptic ulcer. J. A. M. A. 143: 873-877, July 8, 1950.

(4) Smith, C. A.; Woodward, E. R.; Janes, C.; and Dragstedt, L. R.: Effect of banthine on gastric secretion in man and experimental animals. Gastroenterology 15: 718-726, Aug. 1950.

(5) Grimson, K. S.: Clinical trial of banthine in cases of peptic ulcer. Gastroenterology 14: 583-586, Apr. 1950.

TABLE 1.—*Summary of 25 patients treated with banthine*

Group	Complication	Age	Time in service	Duration of gastrointestinal complaint	Predominant symptoms	Occult blood in stool	Gastric acidity	Side effects	Results
1	Hemorrhage	27	7 yr.	10 yr.	Tarry diarrhea, gas pains, weakness, syncope.	+	Total-Free 46-30	D. o. M.	Good
		30	7 yr.	1 wk.	Tarry diarrhea, weakness, syncope.	+	100-80	None	Good
		19	1 mo.	6 yr.	Weakness, tarry diarrhea.	+	n. t.	None	Good
		23	6 mo.	3 yr.	Hematemesis, pain.	+	n. t.	Mild D. o. M.	Good
2	Perforation	27	8 yr.	3 yr.	Pain.	0	138-124	D. o. M.	Good
		34	9½ yr.	9 mo.	Pain.	0	112-64	D. o. M.	Good
		22	1½ yr.	3½ yr.	Pain.	0	n. t.	Mild D. o. M.	?
		23	4 yr.	1 mo.	Pain.	+	90-76	D. o. M.	?
3	Psychosomatic	29	3 wk.	6 yr.	Nervousness, vomiting, pain.	n. t.	n. t.	Mild D. o. M.	Good
		33	1 wk.	13 yr.	Pain, vomiting.	n. t.	n. t.	Blurring of vision	Good
		30	8 yr.	5 yr.	Pain, belching.	n. t.	35-24	None	?
		21	1½ yr.	9 mo.	Pain, vomiting.	+	n. t.	None	?
		23	5 yr.	4 mo.	Pain.	+	68-62	Mild D. o. M.	Good
		25	14 mo.	11 yr.	Pain.	+	n. t.	None	?
		35	17 yr	8 mo.	Pain.	0	95-55	D. o. M.	?
		33	10 yr.	2 yr.	Pain.	+	65-35	D. o. M.	?
		26	2 yr.	5 yr.	Pain.	+	n. t.	D. o. M.	Good
		19	2 wk.	2 yr.	Pain.	0	43-33	None	?
4	None	22	2½ yr.	2 mo.	Pain.	+	n. t.	Mild D. o. M.	Good
		38	4 yr.	3 yr.	Pain.	+	53-44	Severe D. o. M.	Good
		29	8 yr.	2 yr.	Pain.	+	104	Mild D. o. M.	Good
		34	14 yr.	5 yr.	Pain.	n. t.	n. t.	Mild D. o. M.	Good
		29	5 yr.	3 yr.	Pain.	0	n. t.	D. o. M.	Good
		41	22 yr.	10 yr.	Pain.	0	70-52	D. o. M.	Good
		28	11 yr.	6 yr.	Pain.	n. t.	n. t.	Mild constipation	Good

n. t. = not tested for D. o. M. = dryness of mouth and throat

group includes those who were emotionally maladjusted and whose emotional difficulty was believed to be as great as, or greater than, their organic complaints. The results of chemotherapy in this group naturally are much poorer than in the remainder of the series. The last group had no obvious complication.

All of these patients were placed on 100 mg. of banthine every 6 hours for 48 hours, and their dose regulated according to the clinical results and the individual's susceptibility to side reactions. Usually after 48 hours, the doses at 6, 12, and 6 were cut down to 75 or 50 mg. and the night dose maintained at 100 mg. All patients were placed on a progressive Sippy diet, and, on admission the patients with hemorrhage were started on 3 ounces of cream every hour while awake unless vomiting. If vomiting, all oral intake except banthine was withheld for a few hours until intravenous fluids and mild sedation enabled them to take liquids by mouth. Return to full duty with a maintenance dose of banthine was usually accomplished about 6 weeks after a severe hemorrhage, and sooner with the other patients. Some patients were retained longer so that more complete gastric secretion studies could be made. A control period without medication was observed, and then banthine therapy was reinstituted. We found the gastric acidity, both free and total, to be definitely lowered, and night secretions to be reduced in volume from 45 to 75 percent, agreeing with reports in the literature.

SUMMARY

Twenty-one patients or 84 percent of our group were returned to duty for periods varying from 1 to 6 months on a maintenance dose of banthine, and no other medication. Four patients, or 16 percent, were separated from the service, but 3 of these were basic trainees and were discharged for the convenience of the government because their condition existed prior to service, and was considered not in line of duty. The fourth patient was separated prior to the present national emergency. The men on duty are on a regular diet except for the exclusion of such harmful items as spices, roughage, carbonated beverages, alcohol, and tobacco. Although it is too soon to determine the ultimate value of banthine in these patients, it would seem that a greater number of patients with duodenal ulcer are able to lead a nearly normal service existence with banthine than with any previously used medication.

CONCLUSIONS

Banthine lowers gastric secretions both in acidity and in volume. It is an effective gastrointestinal antispasmodic, and is a useful adjunct to the medical management of duodenal ulcer.

Thrombophlebitis[1]

Jack T. Rush, *Lieutenant Colonel, MC, U. S. A.*

James H. Forsee, *Colonel, MC, U. S. A.*

THE ANCIENTS were familar with a condition known to them as phlegmasia alba dolens. This consisted of thrombophlebitis involving the iliofemoral vein resulting in edema, pain, and swelling of the entire leg. Available historical data indicates that Paulus of Aegina about 660 A. D. (2) performed the first operation for this condition by opening the saphenous vein, removing the thrombus, and ligating the vein. The term phlebitis was probably first used by Breschet in 1818. In 1865 Virchow demonstrated that thrombi in the veins were really blood clots and gave a good description of the mechanism of embolus and infarct formation. In 1875, Zahn showed that thrombus formation starts with a nucleus of white blood cells accumulating at the site of vessel injury followed by red-blood-cell agglutination (3). Surgical efforts to control thrombophlebitis by proximal vein ligation have been frequent. The first successful ligations of the inferior vena cava were performed by Bottini in 1906 and by Trendelenburg in 1910 for thrombophlebitis of the pelvic veins in patients with septicemia. One of these patients recovered. Krotski summarized the literature referable to inferior vena cava ligation to 1937, collecting only 48 cases. In 1944, Homans reported 14 cases of surgical ligation of the iliac vein. Thebaut and Ward reported 36 cases of inferior vena cava ligation with two deaths (4). Present methods of management of acute thrombophlebitis of the lower extremities include anticoagulant therapy and/or superficial femoral vein ligation. Heparin and dicumarol were first used clinically in 1941 (5). These drugs have so favorably altered the course of events in thrombophlebitis as to become indispensable in its manage-

---

(1) From the Fitzsimons Army Hospital, Denver, Colo.

(2) Jensen, D. R.: Problem of thrombophlebitis. Ann. Surg. 121: 314-327, Mar. 1945.

(3) Friedlander, E.: Histologic and chemical aspects of thrombus formation. Arch. Surg. 58: 48-53, Jan. 1949.

(4) Thebaut, B. R., and Ward, C. S.: Ligation of inferior vena cava in thromboembolism; report of 36 cases. Surg., Gynec. & Obst. 84: 385-401, Apr. 1947.

(5) Link, K. P.: Anticoagulant from spoiled sweet clover hay. The Harvey Lectures, Volume 39. Science Press Printing Co., Lancaster, Pa., 1943. pp. 162-216.

ment. The employment of superficial femoral vein ligation was emphasized by Allen *(6)* and others.

Intravascular clotting is more frequently encountered in patients of advanced age. Probably over 80 percent of the clinical manifestations are in patients over 40 years of age. Barker et al. *(7)* reported an incidence of 0.96 percent following surgical operations of all types, 2 percent for laparotomies (except repair of hernias), and 3 percent if the procedure was performed on the female pelvis. Crafoord and Jorpes *(8)* reported two postoperative series with a total of 1,111 patients who did not receive any anticoagulant therapy and in whom the incidence of thrombophlebitis was 6 and 9 percent. At this hospital from 1939 to 1949, 2,104 autopsies were performed; 28 (1.3 percent) deaths were caused by pulmonary emboli and/or infarcts. From 1 January 1947 to 31 December 1949 there were 42,939 admissions; 8,000 major operations, exclusive of the ear, eye, and nose, were performed; and 2,491 women were delivered. During this period there were 100 cases of acute thrombophelebitis (0.23 percent of all admissions); 38 (0.47 percent) occurred following operations and 7 (0.19 percent) followed 2,491 deliveries. There were 14 pulmonary infarcts; 4 occurring postoperatively and none postpartum.

The patient census at this hospital ranges from 2,000 to 2,500; about half being tuberculous or neuropsychiatric patients; the other half being about equally divided between general medical and surgical patients.The patients come from practically every walk of life. Many are soldiers and veterans, the others being retired military personnel or civilian dependents. Because most of the patients are young soldiers the average age of those undergoing operation is about 35 years. The incidence of thrombophlebitis is low, especially when one considers the large number of patients confined to bed with tuberculosis. The constant awareness of all medical officers of the dangers of thrombophlebitis or phlebothrombosis occurring in this type of patient has lead to particular attention being given to leg exercises. Meticulous preoperative surgical preparation directed toward securing normal blood protein levels and hemoglobin content are also believed to have favorably influenced this rate. Each patient is visited several times daily during the postoperative period by experienced medical officers who encourage the patients to move their legs and wiggle their toes; early ambulation is diligently practiced. The generally accepted sharp distinction between acute thrombophlebitis and phlebothrombosis has not, in our experience, been clear.

(6) Allen, A. W.: Interruption of deep veins of lower extremities in prevention and treatment of thrombosis and embolism. Surg., Gynec. & Obst. 84: 519-527, Apr. (No. 4A) 1947.

(7) Barker, N. W.; Nygaard, K. K.; Walters, W.; and Priestley, J. T.: Statistical study of postoperative venous thrombosis and pulmonary embolism; incidence in various types of operations. Proc. Staff Meet. Mayo Clin. 15: 769-773, Dec. 4, 1940.

(8) Crafoord, C., and Jorpes, E.: Heparin as prophylactic against thrombosis. J. A. M. A. 116: 2831-2835, June 28, 1941.

Intravenous clotting is caused by (1) changes resulting from an increase in the platelet count or a change in the prothrombin, fibrinogen, or calcium content of the blood; (2) stasis resulting from slowing of the blood within the veins; and (3) external or internal tissue injury. Such factors as advanced age, obesity, degenerative diseases, cardiovascular disease, and bed rest predispose to intravenous clotting. Blood chemical alterations such as hypoproteinemia, hyperglobulinemia, increased fibrinogen content, increased calcium content, and decreased carbon dioxide combining power, all seem to predispose to thrombus formation. Of the 100 cases of acute thrombophlebitis herein reported, 38 were postoperative, 7 were postpartum, 24 were of undetermined origin, 9 were associated with recurrent thrombophlebitis, 11 occurred in a variety of medical conditions, 3 were secondary to fracture of the long bones, 3 occurred secondary to varicose veins, and 5 were associated with contusions.

The normal clotting mechanism is usually initiated by tissue damage either mechanical or infectious, or from a slowing of the circulation with irritation of the endothelial linings of the veins. In this mechanism thrombokinase is liberated, neutralizing the antithrombin which allows prothrombin to combine with calcium in the presence of vitamin K to form thrombin. Thrombin stimulates fibrinogen to form fibrin which is a framework on which the clot forms. In this meshwork of fibrin the platelets are agglutinated to form the nucleus around which white and red blood cells are agglutinated. A thrombus consists of a "white head" adherent to the vascular wall and a "red tail" fixed at one end to the white head with the other end floating freely in the blood stream. Loose, coagulated, red blood cells which are attached to the floating tail of the clot may at any time break loose, acting as free-floating bodies from the veins of the legs and pass through the inferior vena cava and right heart to the lungs. If the embolus is small the patient may have only slight dyspnea, pain, and hemoptysis which clears spontaneously. If the embolus is large, the patient may develop a pulmonary infarct with serious complications.

The diagnosis of acute thrombophlebitis is usually easily made by properly evaluating the symptoms. Of the 100 patients having acute thrombophlebitis at this hospital the initial symptoms were pain in the calf of the leg (62 percent), pain in the thigh or groin(23 percent), or sudden pain in the chest with dyspnea and hemoptysis (12 percent). The most important physical finding is tenderness in the calf of the leg and along the popliteal and femoral veins. This tenderness is often the first sign of acute thrombophlebitis and may be elicited by careful examination before the patient is aware of any discomfort and was noted on palpation in 83 percent of our patients. Homans' sign (pain in the calf and popliteal space or dorsiflexion of the foot) was present in 75 percent. The diagnosis is further confirmed by the presence of swelling of the leg, increased temperature, and dilated superficial veins.

After the diagnosis of acute thrombophlebitis is made it is our practice to place the patient at bed rest, elevate the affected extremity, and, if there is infection or cellulitis, 300,000 units of penicillin is given daily until the infection subsides; 50 mg. of heparin is given intravenously every 4 hours for 36 hours; 300 mg. of dicumarol the first day, 200 mg. the second day, and 100 mg. the third day given orally is generally prescribed for a 150-pound adult. A daily prothrombin time determination is obtained and dicumarol sufficient to keep the prothrombin level at about 20 percent of normal is given. Patients are allowed out of bed as soon as the acute inflammation has subsided and it is no longer painful for them to walk. Dicumarol is continued until tenderness has disappeared, usually from 14 to 21 days. Residual tenderness in the calf muscles is often improved by short-wave diathermy. In our series there has been no excessive bleeding associated with anticoagulant therapy. If an operation becomes necessary on a patient receiving anticoagulant therapy the prothrombin time should be brought above 35 percent of normal by the use of whole blood transfusions and vitamin K.

The only indication we have used for proximal venous ligation is the failure of anticoagulant therapy to prevent recurrent pulmonary emboli. Two patients required proximal venous ligation. One patient had an inferior vena cava ligation after anticoagulant therapy and bilateral superficial femoral vein ligation which failed to prevent pulmonary emboli. No more emboli occurred and the patient returned to full military duty 2 months after operation. The other patient had multiple pulmonary emboli from a recurrent thrombophlebitis of the right leg which did not respond to anticoagulant therapy. A right common iliac vein ligation achieved good results. Adequate anticoagulant therapy greatly aided in effective control of acute thrombophlebitis in 97 percent of our patients. If arteriospasm with edema is a prominent symptom, daily lumbar sympathetic blocks with 1 percent procaine are performed until the edema subsides.

We have used heparin-dicumarol therapy: (1) in all patients with acute thrombophlebitis as an aid in preventing spread of the thrombus, (2) in the presence of pulmonary embolism, (3) as a prophylaxis against postoperative thrombophlebitis in debilitated patients who are to be confined to bed for long periods postoperatively, (4) as a prophylaxis against thrombosis following splenectomy when the platelet count rises above 500,000, (5) occasionally to prevent thrombosis in an artery following an arterial operation, and (6) occasionally in patients with advanced arteriosclerosis to prevent thrombosis.

We have considered the following as contraindications to heparin and dicumarol therapy: (1) recent operations on the brain and spinal cord, (2) the presence of recent excessive bleeding of undetermined cause, and (3) the late antepartum period.

The complications of thrombophlebitis are pulmonary emboli which may occur early preceding the symptoms of thrombophlebitis and the

postphlebitis syndrome with chronic venostasis, which is a late complication and may not develop for several years after the acute attack. The onset of pulmonary embolism is usually characterized by sudden dyspnea followed by pain in the chest. A rapid pulse, marked restlessness, difficult rapid breathing, pallor, and sweating are the indications of shock accompanying a severe pulmonary embolism. Hemoptysis is present in about 50 percent of the patients. A friction rub, roentgenographic evidence of increased density or mottling (fig. 1) with electro-

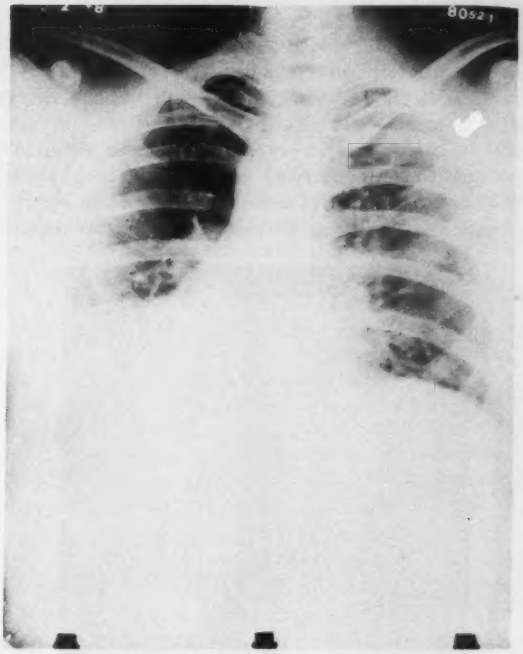


Figure 1.—Infarct of left lung following acute thrombophlebitis of right leg.

cardiographic evidence simulating acute cor pulmonale has been of greatest aid in the presence of relatively large infarcts. In this series of 14 patients presenting findings of pulmonary emboli, symptoms of acute thrombophlebitis were present or followed within 24 hours. Patients with pulmonary emboli require emergency treatment consisting of a semisitting position, oxygen, and 0.8 mg. of atropine every 4 hours. A bedside chest roentgenogram should be secured as soon as the patient's condition permits and an electrocardiographic tracing obtained without disturbing the patient. Pain is probably best relieved by the immediate hypodermic injection of 100 mg. of demerol hydrochloride.

An intravenous infusion of normal saline solution containing about 200 mg. of heparin per liter should be started at the rate of 25 drops per minute and continued until the urgent symptoms have subsided. The coagulation time (Lee-White method) should be kept well over 15 minutes. The only death from pulmonary embolism in this series, occurred in a 74-year-old Negro who had been operated on because of a ruptured appendix. He was allowed up on the second postoperative day and on the fifth postoperative day died suddenly without preceding symptoms or anticoagulant therapy. Postmortem examination revealed a massive pulmonary embolus.

The diagnosis of chronic venous insufficiency caused by old thrombophlebitis with obstruction and recanalization of the deep vessels of the thigh and leg is made by physical examination, determining the venous pressures in the veins of the extremities, and by phlebography. The extremity is characteristically noted to have varying degrees of cyanosis, subcutaneous induration, edema, dilated superficial veins, dermatitis, pigmentation, and ulceration of the skin about the ankle (fig. 2). Venous pressures taken in the ankle veins reveal measurements

Figure 2.—Patient with mild edema, venous distention, cyanosis, induration, and pigmentation about the ankle.

of from 20 to 30 cm. of water. If the superficial femoral vein has become markedly recanalized, this venous pressure decreases. Phlebograms of the extremities usually reveal obstruction of the deep veins of the calf, marked dilatation and tortuosity of the superficial veins, obliteration of the popliteal and superficial femoral vein, and evidence of new anastomotic channels (fig. 3). Homans (9) reported that once obstructive thrombophlebitis has become established in the femoroiliac veins, edema in some degree persists. Bauer (10) wrote that a deficient venous return is responsible for the edema and depreciates the lymphatic and vasoconstricting elements in the production of the edema. The recanalized vein is regarded as a source of back pressure of venous blood in the extremity and superficial femoral vein ligation and excision of a segment usually gives good symptomatic results in properly selected cases. The leg does not seem to be as heavy or congested and there is improvement in the circulation. The explanation offered for this improvement is that the superficial femoral vein is functionally useless and is best eliminated as adequate collateral circulation has been established. In our experience with 25 patients beneficial results have generally followed but the edema has seldom been markedly influenced by the operation. Lumbar sympathectomy is indicated in certain patients.

Figure 3.—Phlebogram showing nonfilling of deep calf, popliteal, and femoral veins.

SUMMARY

Ninety-nine patients with acute thrombophlebitis occurring in 42,939 admissions to this hospital were treated with anticoagulants between 1 January 1947 and 31 December 1949. The results were satisfactory in 97 patients; 2 required inferior vena cava or right common iliac vein ligation to prevent further pulmonary emboli. One 74-year-old patient died of pulmonary emboli, suddenly and without having received anticoagulant therapy following appendectomy. Penicillin is used in the presence of cellulitis. Lumbar sympathetic nerve block has been especially beneficial in relieving arteriospasm. Short-wave diathermy is

(9) Homans, J.: Late results of femoral thrombophlebitis and their treatment. New England J. Med. 235: 249-253, Aug. 22, 1946.

(10) Bauer, G. A.: Roentgenological and clinical study of sequels of thrombosis. Acta. chir. Scandinav. 86: (Supp.) 74, 1942.

of value in treating the postphlebitis fibrositis. The occurrence of pulmonary emboli can be minimized by meticulous pre- and post-operative care. Patients with pulmonary emboli require immediate therapy. Postphlebitic venostasis has been treated with good symptomatic results by superficial femoral vein ligation combined when indicated with lumbar sympathectomy.

Hydrophilic Forms of Tars

Solomon C. Pflag, *Lieutenant, MSC, U. S. N.* (1)

Louis C. Zopf, M. S. (2)

THE TARS for many decades have been important members of the armamentarium of the dermatologist. Because they offered a great challenge to pharmacists in their quest for more esthetic and pharmaceutically elegant preparations, this problem was studied. Tars are products obtained in the destructive distillation of various organic substances. Although they vary in color, viscosity, and chemical composition depending on the materials they are derived from, and the method of production involved, they have the annoying and common characteristic of not being soluble or miscible in water.

One of the most commonly used tars, coal tar, is obtained from the destructive distillation of bituminous coal. Low-temperature coal tars (those distilled at about 600° C.) (3) differ greatly from the high-temperature coal tars (distilled at 1,400° C.) (4). The former contain unsaturated hydrocarbons, naphthenes, paraffins, phenols, and pyridines, whereas the latter consist of benzol and its homologues, naphthalene, anthracene, phenathrene, solid aromatic bodies, and substantially higher percentages of free carbon (4). One can therefore theorize that high-temperature tars result from the decomposition of low-temperature tars and that because we are evaluating two chemically different products, the therapeutic response will not be consistent.

There is much confusion concerning the relative merits of high- versus low-temperature coal tars. Combes (5, 6) stated that low-temperature coal tars are desirable medicinally. Downing and Bauer (7),

(1) U. S. Naval Hospital Corps School, San Diego, Calif.

(2) Member, Revision Committee of the U. S. Pharmacopoeia.

(3) Morgan, G. T.: Chemistry of low-temperature tar. J. Soc. Chemical Industry 51: 67 T, 1932.

(4) Abraham, H.: Asphalts and Allied Substances. Volume I. 5th edition. D. Van Nostrand Company, New York, N. Y., 1945.

(5) Combes, F. C.: Coal tar in dermatology; improvement in its physical properties without any change in its therapeutic action. Arch. Dermat. Syph. 56: 583-588, Nov. 1947.

(6) Combes, F. C.: Coal tar in medicine; brief study of its manufacture, composition and use in industrial dermatitis. Indust. Med. 13: 550-552, July 1944.

(7) Downing, J. G., and Bauer, C. W.: Low and high-temperature coal tars in treatment of eczema and psoriasis; clinical investigation and evaluation. Arch. Dermat. Syph. 57: 985-990, June 1948.

on the other hand, found that high-temperature tars produced a better clinical response when they used alcoholic extracts of high- and low-temperature tars in an ointment base.

The objective of this article is: (1) to direct the attention of the medical and pharmaceutical professions and the Committee of the Revision of the U. S. Pharmacopoeia to the need for suitable standards for coal tar; (2) to devise a simple test to distinguish between high- and low-temperature coal tars; (3) to increase the range of usefulness of tars by rendering them water-dispersible and thus permit the production of finer pharmaceuticals; and (4) to produce smoother, more uniform coal-tar-ointment preparations. Obermayer and Becker (8) stated that coal tars which have had fractions removed have one property in common—"their total pharmacologic effect is usually less than that of original crude coal tar." In this investigation no attempt was made to remove any fractions nor to modify the normally occurring constituents of the coal and wood tars.

EXPERIMENTAL DATA

In order to develop a water-dispersible tar, it was deemed advisable to experiment with many surface-active agents (detergents, dispersing agents, emulsifiers, solubilizers, and surface tension depressants). Many anionic agents, as for example, sodium lauryl sulfate, were tried along with such cationic substances as the quaternary ammonium salts, and in each case the tars could not be made to disperse satisfactorily in aqueous vehicles. The nonionic agents represented by polyoxyethylene sorbitan monolaurate (tween 20) gave the most satisfactory results.

Aqueous lotions.—Tween 20 was mixed with crude coal tar in varying proportions. Distilled water was added with constant stirring and a well-dispersed tar-in-water mixture resulted. This mixture was a combination emulsion and dispersion of solid particles (pitch and resins) of tar. A satisfactory ratio between tween 20 and the crude coal tar was established as 4 parts by weight of tween 20 to 1 of crude coal tar. The tween 20 was mixed with the coal tar in a mortar, and the aqueous vehicle was slowly added with constant trituration. The resulting product had a very small particle size. A lotion prepared by the following formula gave a particle size of about 21 microns:

Crude coal tar	1
Tween 20	4
Zinc oxide	16
Glycerin	2
Bentonite magma	40
Calcium hydroxide solution, U. S. P., to make	100

(8) Obermayer, M. E., and Becker, S. W.: Study of crude coal tar and allied substances; preliminary report. Arch. Dermat. Syph. 31: 796-810, June 1935.

The coal tar was evenly dispersed throughout the lotion. After application to the skin the lotion was easily removed with soap and water. Thus, coal tar can now be prescribed in aqueous vehicles and a well-recognized incompatibility is overcome. The range of usefulness of coal tar is thus increased and offers many new possibilities. Tween 20-coal tar mixtures were found to be compatible with aqueous vehicles, collodion *(9)*, tincture of green soap, pectin, and tragacanth pastes *(10)*. It was incompatible with fixed oils, mineral oil, and alcoholic solutions containing alcohol in excess of 10 percent.

Because of the similarity of polyethylene glycol 400 monolaurate and polyethylene glycol 400 dilaurate to tween 20 *(11)*, these agents were tried. It was found that polyethylene glycol 400 monolaurate could be added to crude coal tar in the same proportions as tween 20 and that the resultant mixture had properties similar to those of the tween 20-coal tar mixture. Polyethylene glycol 400 dilaurate-coal tar mixtures were found to be compatible with fixed oils and are recommended for coal tar-fixed oil mixtures.

Ointments.—It was found that certain nonionic agents mixed with coal tar and incorporated in ointment bases, markedly reduced the particle size of coal tar in the finished ointment. Successful results were obtained through use of the following: (1) tween 20, 40 *(12)*, 60 *(13)*, and 80 *(14)*; (2) polyethylene glycol 400 monolaurate; (3) polyethylene glycol 400 monostearate; and (4) polyethylene glycol 400 dilaurate. The coal tar particle size was reduced from 100 to less than 3 microns in coal tar ointment (U. S. P.) by the use of the nonionic agents mentioned. The resulting ointment was smooth, grit-free, and homogeneous. The increased hydrophilic property of these ointments aided in absorbing exudates.

In an investigation designed to determine the minimum amount of these nonionic agents to be used in conjunction with crude coal tar in Lassar's paste, it was found that one-half part of these nonionic agents mixed with one part of crude coal tar was satisfactory. Particle size was reduced many times. In all cases 1 percent crude coal tar (high-temperature) was thoroughly mixed with the tween 20 before being incorporated with Lassar's paste. The hydrophilic properties of the finished product varied in direct proportion to the amount of tween 20 added. Ointments prepared with mixtures of coal tar and the nonionic agents were stable at room temperature and as far as can be determined,

(9) The Pharmacopoeia of the United States of America. 13th edition. Mack Publishing Co., Easton, Pa., 1947.

(10) Cook, E. F., and Martin, E. W.: Remington's Practice of Pharmacy. 9th edition. Mack Publishing Co., Easton, Pa., 1948.

(11) Drug and Cosmetic Emulsions. Atlas Powder Co., Wilmington, Del., 1947.

(12) Polyethylene sorbitan monopalmitate.

(13) Polyethylene sorbitan monostearate.

(14) Polyethylene sorbitan monooleate.

in the time allotted, were no more irritating than other coal tar ointments. It might be added that a total of 200 pounds of ointment was employed at the University of Iowa Hospitals in evaluating these clinical results.

Krantz *(15)* in extensive pharmacologic investigation over a period of 5 years found that tweens applied to skin and mucous membranes were not harmful to tissue. Different methods of compounding coal tar ointments containing these nonionic agents produced consistent results. White (16) using a modified Lassar's paste with 5 percent crude coal tar stated that it was necessary to mix the coal tar with the zinc oxide, and the starch with the petrolatum and then to combine the two. The resulting product was claimed to be smooth. Our results indicate that, with the exception of the fusion method, if the crude coal tar is first mixed with the nonionic agent, results can be duplicated no matter how it is incorporated. This point is important. The many different methods of incorporation as practiced by pharmacists will result in a uniform product. It is recommended that coal tar ointment (U. S. P.) be manufactured with one of these nonionic agents in the same proportions as indicated by this work.

Hartman and Zopf *(17)* suggested that smaller amounts of coal tar be used when surface-active agents are combined with coal tar because in these mixtures the coal tar comes more intimately into contact with the skin. Our findings confirm this work.

Standardization of coal tar.—Adam et al. *(18)* succeeded in standardizing coal tar by isolation of the residual solids through the use of benzene and light liquid petroleum. This test involved the use of a distillation apparatus and was time consuming. In preliminary tests conducted with tween 20-coal tar mixture, it was found possible to isolate the residual solids of coal tar as follows:

Two grams of coal tar were mixed with 8 grams of tween 20. The mixture was then poured into 100 cc. of distilled water and rapidly stirred. The mixture was filtered through hard filter paper (No. 50). The precipitate was washed with distilled water until free of soluble material as indicated by a clear, colorless filtrate. It was then air-dried and weighed. The percent precipitate was then calculated. It was found that low-temperature tars averaged from 5 to 10 percent precipitate whereas high-temperature tars gave higher percentages averaging from 40 tp 60 percent.

---

(15) Krantz, J. C.: Feeding Test Studies on Mannitol and Sorbitol and Some of Their Fatty Acid Reaction Products. Atlas Powder Co., Wilmington, Del.

(16) White, C. J.: Crude coal tar in dermatology. Arch. Dermat. & Syph. 4: 796, Dec. 1921.

(17) Hartman, M., and Zopf, L. C.: Notes on levigating agents and incorporation procedures for compounding ointments. J. Am. Pharm. A. Practical Pharmaceutical Edition, 214-217, Apr. 1949.

(18) Adam, W. G.; Shannon, W. V.; and Sach, J. S.: Road Tars. Journal of the Society of Chemical Industry 56: 414 T, 1937

Wood tars.—In experiments designed to solubilize juniper tar (cade oil), it was found that 3 parts by weight of tween 20 was needed to solubilize 1 part by weight of juniper tar. The resulting mixture, tween 20-juniper tar, when diluted with distilled water in all proportions, produced a clear, transparent solution. A 1 percent solution of juniper tar in distilled water prepared in this manner and placed in an ordinary flint bottle has been stable for over 6 months and showed no signs of separating. Polyethylene glycol 400 monolaurate and sulfonated castor oil, on the other hand, produced opaque emulsions from which the oil of cade separated after 24 hours. Pine tar mixed with 4 parts of tween 20 produced a transparent emulsion. Polyethylene glycol 400 monolaurate produced an opaque emulsion which was unstable after 24 hours and liberated free pine tar.

SUMMARY

A hydrophilic coal tar formula using tween 20 or polyethylene glycol 400 monolaurate is presented. The particle size of coal tar in ointment bases is reduced by means of these preparations. It is recommended that coal tar ointment (U. S. P.) be manufactured with one of these nonionic agents in the same proportions as indicated by this work. A possible standardization procedure for coal tar is suggested. A formula for solubilized wood tar is presented.

960522 O - 51 - 5

ARTICLES BY PERSONNEL OF THE MEDICAL SERVICES OF THE ARMED FORCES PUBLISHED IN OTHER JOURNALS

Palmer, H. B., Lt. Col., U. S. A. F. (DC); Overstreet, S.; and Sacks, M.: Evaluation of various technics for reducing decalcification of enamel. Part II. In matched enamel-dentin fragments. J. Dent. Research 30: 189-194, Apr. 1951; Part III. Progressive study of decalcification. J. Dent. Research 30: 195-202, Apr. 1951.

Palmer, H. B., Lt. Col., U. S. A. F. (DC); Overstreet, S.; and Sacks, M.: Alkaline and acidulated fluoride solutions for reducing decalcification of enamel. J. Dent. Research 30: 363-370, June 1951.

Phillips, R. B., Capt., MC, U. S. N.: Medical aspects of the naval air reserve. Mil. Surgeon 108: 304-308, Apr. 1951.

Radke, R. A., Col., MC, U. S. A.: Treatment of amebiasis with atabrine combined with carbarsone. Ann. Int. Med. 34: 1432-1444, June 1951.

Walker, W. J., Lt. Col., MC, U. S. A., and Wier, J. A., Lt. Col., MC, U. S. A.: Plasma cholesterol levels during rapid weight reduction. Circulation 3: 864-866, June 1951.

Walker, W. J., Lt. Col., MC, U. S. A.: The patient with functional cardiovascular disorders (neurocirculatory asthenia). Am. Heart J. 42: 97-114, July 1951.

Tantalum Foil Used in Closing Antro-Oral Fistulas

Earle J. McClung, *Colonel, DC, U. S. A.* (1)

James E. Chipps, *Major, DC, U. S. A.* (1)

IN CLOSING chronic antro-oral fistulas of the alveolar ridge, most operators use some plastic surgical procedure because those methods which might permit a simple approximation of the wound edges frequently result in failure. The most satisfactory method of closure consists of excising the fistula, raising a pedicle flap from the palatal tissue, turning the flap across the alveolar defect, and inserting the free end of the flap beneath the undermined buccal mucosa (2). Thoma has discussed certain disadvantages associated with the method. The donor site is denuded and requires postoperative care. The exposed palatal bone is subject to secondary infection. The flap may break down from inadequate blood supply caused by improper design, excessive suture tension, or secondary infection. Furthermore the elevated tissue resulting from turning the flap and the depression remaining in the donor site may so alter the mucosal contour that the patient may no longer be able to wear a previously-constructed denture and new denture construction may have to be postponed until healing is nearly complete.

Bellinger (3) has described the properties and some of the uses of tantalum in oral surgery, noting that the metal does not seem to produce a foreign-body tissue reaction and that exposure of the metal to the mouth does not seem to interfere with its tolerance by the tissues. He described a patient in whom a large tantalum splint was used following partial mandibular resection. The splint was exposed to the mouth throughout its length but there was a gradual proliferation of mucosa from the edges which eventually covered the splint. Bellinger also mentioned that he had used tantalum sheet in the closure of an antro-oral opening that had resisted five previous attempts at closure.

(1) Madigan General Hospital, Tacoma, Wash.

(2) Thoma, K. H.: Oral Surgery. C. V. Mosby Company, St. Louis, Mo., 1948. Vol. 1, pp. 764-769.

(3) Bellinger, D. H.: Preliminary report on use of tantalum in maxillofacial and oral surgery. J. Oral Surg. 5: 109-122, Apr. 1947.

We have successfully used tantalum foil in four chronic antro-oral fistulas. The tantalum was inserted by simple surgical procedures which precluded the disadvantages associated with raising a pedicle flap. Each patient gave a history of one or more previous attempts to obtain a closure. The postoperative courses were remarkably uniform. A typical case is reported.

CASE REPORT

A 40-year-old man had all of his teeth removed and dentures constructed in March 1949. He noted the continuing accumulation of mucopurulent debris beneath his denture and the passage of air into his mouth when he blew his nose. An antro-oral fistula in the left maxillary first molar area was diagnosed by his dentist and an unsuccessful attempt at closure was performed. In June 1949, the patient was hospitalized because of an acute maxillary sinusitis. A Caldwell-Luc operation was performed. During this procedure, a second unsuccessful attempt was made to close the fistula. After observations and treatments for sinusitis until November 1949, he was referred to our clinic symptom-free except for the presence of the fistula.

Radiographs showed no gross changes in the sinuses and good nasal drainage of the left maxillary sinus provided by an opening about 1 cm. in diameter in the wall of the inferior nasal meatus which resulted from the recent Caldwell-Luc operation. A small antro-oral fistula was present in the left first molar area. A yellow discharge could be obtained through the fistula when the patient blew his nose with the nostrils closed.

He was given 50,000 units of penicillin every 3 hours. Under procaine anesthesia, the fistula was narrowly excised and the chronic inflammatory tissues present in the bone defect and at the intra-antral margins of the fistula were removed by curettage. An incision along the crest of the alveolar ridge was made through the fistula site. It was of sufficient length that when forked anteriorly and carried palatally and buccally, palatal and buccal flaps could be raised sufficiently to expose the entire bony defect. These flaps were slightly undermined and a piece of tantalum foil, 0.00025-inch thick and about 1 inch in diameter, was burnished over the bony defect and tucked beneath the undermined flaps. The flaps were reapproximated and sutured without tension, the foil remaining exposed slightly at the previous fistula site. The patient's upper denture was inserted over the operative area.

Three days after operation the wound was seen to be healing throughout its length except for the slight defect at the fistula site where about 3 mm. of foil remained visible. The patient had no complaints, was wearing his denture normally, and no discharge was noted during gentle attempts at nose-blowing. The sutures were removed and penicillin was discontinued. The patient was directed to report for observation at weekly intervals. It was at first hoped that regeneration of the

Figure 1.—Superficial tissue retraction exposing anterior margin of tantalum foil 9 weeks after insertion.

mucosa from the wound edges would result in complete coverage of the foil in a manner similar to that of the patient described by Bellinger. By the end of the third week, however, it was evident that instead of regenerating, the mucosa was slowly retracting, more and more of the foil becoming visible. It was thought that the procedure had probably failed but as there was no discharge and the patient had no complaints, no interference was attempted.

By the end of the ninth postoperative week, retraction of the mucosal edges had progressed so that the anterior edge of the tantalum foil was visible (fig. 1). The tantalum was then removed by grasping its edge with a tissue forceps. It was found that the bony defect deep to the tantalum was completely covered with late-stage granulation tis-

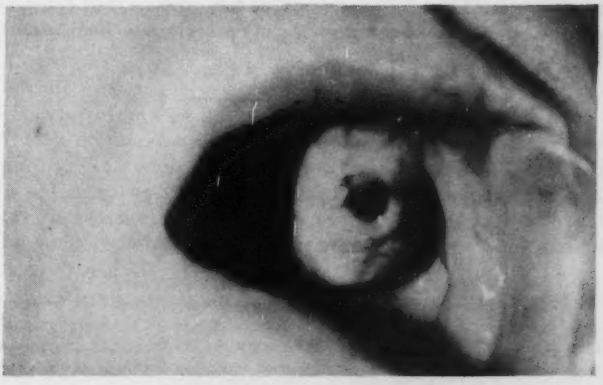


Figure 2.—Immediately after removal of tantalum foil showing the new tissue which had closed the defect.

sue (fig. 2). The new tissue was not hemorrhagic and could not be probed. In subsequent weeks, the redness in the new tissue gradually faded and the area was apparently covered by normal epithelium.

COMMENT

Three patients later treated in this way showed similar postoperative courses. After gradual retraction of the superficial wound edges for from 7 to 9 weeks, the tantalum was removed to reveal a closure of the defect with new tissue deep to the tantalum insert. We believe that the tantalum (1) acted as a mechanical dam, preventing the movement of fluids through the wound with the frequent pressure changes which accompany sucking, swallowing, inhalation, or exhalation; and (2) served as a support for the blood clot and subsequent granulation tissue forming on its deep surface. We have used tantalum foil of 0.00025-inch, 0.00050-inch, and 0.0125-inch thickness. Similar results were obtained in each instance, but the thinner foil was most easily manipulated.

Our four patients were endentulous and we have had no opportunity to use this technic in a fistula existing between adjacent teeth. In such a case, we have thought that a butterfly-shaped piece of foil inserted beneath buccal and palatal flaps raised by incisions about the necks of the adjacent teeth might prove successful.

CONCLUSIONS

The important points for consideration in this procedure seem to be: (1) elimination of gross antral changes before attempting closure; (2) establishing moderate hemorrhage by curettage deep to the tantalum foil; and (3) eventual removal of the foil. Some patients might show complete closure both deep and superficial to the foil, in which case the foil could be permanently left in place. In patients similar to ours, however, removal of the foil seems to be the only method for satisfying the patient and the operator that an actual closure has been accomplished.

The Improvement of Professional Relations in Hospitals[1]

Richard A. Kern, M. D. [2]

THE improvement of relations in a hospital between members of its professional and also its nonprofessional staff is a matter of prime importance to those who are charged with hospital administration. Some of the differences between the running of a civilian hospital and the running of a service hospital are not clearly understood by all concerned. An example of this appeared in a publication of the Hoover Commission, *Reorganization News,* in November 1949. Set off in a box to attract attention, and under the heading, "Can't we save some money here?" the Commission reported the following figures for "length of stay in days" for nonfederal and for Army and Navy hospitals: Tonsillectomy, in nonfederal hospitals 1.4 days, in Navy hospitals 13.3 days, in Army hospitals 16.1 days; appendectomy, in nonfederal hospitals 7.8 days, in Navy hospitals 20.3 days, and so on.

Having spent nearly 7 years of my professional career in active naval service and having had frequent contact with service medicine during another 30 years, I promptly wrote the editor that a destroyer at sea was no place for a patient 1.4 days after a tonsillectomy or 7.8 days after an appendectomy: if the editor did not believe it, let him try being seasick under those circumstances. Civilians do not know that such convalescent patients in service hospitals are treated in a most economical fashion, in that for one thing, all of them are fed cafeteria-style; no civilian hospital that I know of has cafeteria service for ambulatory patients. Furthermore civilians do not realize that such convalescent patients are assigned to working parties as soon as their condition permits, and that they so contribute more and more to their

---

(1) Presented before the Inter-Agency Seminar on Hospital Administration, at the National Naval Medical Center, Bethesda, Md., 23 April 1951.

(2) Commodore, MC, U. S. N. R. (Inactive). Professor of Medicine and Head of the Department, Temple University School of Medicine, Philadelphia, Pa.

own maintenance. On my second day of active duty in a naval hospital I proudly discharged to duty a patient who had been in the hospital 88 days for mumps. My ears still tingle at the memory of what the Skipper had to say to me for depriving the hospital of the services of the best carpenter in the Fourth Naval District.

The problems in the field of professional relations in our hospitals have their origin largely in the greatly increased complexity of modern medical practice. Every aspect of the care of the patient and the responsibility for that care has been more and more subdivided among more and more persons, an increasing number of whom are not physicians, but include nurses and technicians each with special medical and also nonmedical skills and functions. This trend is moving the physician ever further away from contact with, and a knowledge of the ancillary services that help to make up a modern hospital. Moreover, the 4 years of medical school teachings are so crowded with the need for imparting medical facts that deans and professors are ever more reluctant to allot precious hours in the curriculum to nonmedical subjects, a knowledge of which is nevertheless so necessary. As a result, the average physician at graduation knows far too little about such things as nursing, dietetics, pharmaceutical matters, the problems of supply and hospital maintenance, and of social service.

Let me cite one example of such increased complexity in hospital function: the feeding of our patients. When I became an intern in 1914 in an excellent 350-bed university hospital, a central galley, presided over by a chef with hotel training, took care of all in the institution. A nurse trained in dietetics exercised mild supervision. There were just 3 diet prescriptions: liquid diet, soft diet, and full diet. The only modification in any frequent use was supplemental feeding in the form of eggnog, with or without whisky. Think of the multiplicity (and the cost!) of the many special diets of today, and the important function of the dietician.

The first point that I wish to emphasize is the need of some systematic instruction of physicians in the functioning of the ancillary services of a hospital. I do not mean that we should make a hospital administrator out of every physician, but simply that he should be made aware of the existence of these services and to know a little of the way in which they function. Such instruction must begin at the medical student level. Whenever possible, it ought to be instruction of a practical kind. Take pharmacy, for example. At some time early in his duty as a clinical clerk in the third year, every student should be required to spend several hours in the drug room of the hospital, see what the pharmacist does, learn a little of what drugs look like and what they cost, and get some advice from the pharmacist how to avoid making the mistakes that doctors most often commit in writing prescriptions.

He should accompany a social service worker in the actual work-up of one of his patients, including not only the obtaining of the usual

social history, but, if possible, a visit to the patient's home to see how important the environment is in the treatment, not of a disease, but of a person who happens to be ill. In the same way, he should have contact with the laboratories, see what a burden of work and of expense every request for a test involves, and how much of it is unnecessary. Such instruction at the student level is now being carried out in many places.

The instruction should be continued at the intern level. Here little is being done today in any of our hospitals, service or civilian. We take for granted that the M. D. degree in some magical way transforms the senior student in June into a competent intern in July who needs no more formal instruction, but merely to accumulate so-called "experience." Yet he is woefully ignorant about nearly everything that pertains to the operation of a hospital. For example, his knowledge of practical nursing is close to the level of the absolute zero. The least he should do is read an elementary text on the subject. He can learn much by casual observation of the nursing of his patients. It would be better if there were occasional demonstrations of certain nursing technics.

In every service hospital it is recognized that the new intern needs to be "indoctrinated" in certain matters of routine, custom, and procedure peculiar to that service. Therefore soon after his arrival he receives instruction in such matters, well known to all of you. Is it not equally desirable to teach him something about many other aspects of the practical operation of a hospital? He ought to be taken on a tour of the commissary department, to get some inkling of food procurement, processing, inspection, and cost. He should be required at some early date to inspect the food trays as they are served to patients and then to check those same trays after leaving the patients. Food wastage is a most important item in the case of the daily ration. Such tray inspection might teach him that he is responsible for much of the wastage, when he sees on the outgoing tray the uneaten meat, the costliest of food items, which an edentulous patient could not chew. Now, nearly everyone who has anything to do with the ordering and serving of food to our patients (the intern, the junior staff member, the nurse, the hospital corpsman, the dietitian) is a young person with plenty of teeth of his own who does not give a thought to the teeth of his patients. Yet the aged and toothless comprise the majority of the patients in all civilian general hospitals, and a growing proportion even in our service institutions.

In the same way, he should be introduced to the several other nonprofessional activities of the hospital: the engineering department, the machine shop, the various maintenance services. He should know the chief electrician, carpenter, and painter. He should develop a consciousness of the significance of a dripping faucet, an open window in winter, an unneeded burning light in terms of the waste they imply.

It is indeed important to indoctrinate the intern and junior physician in what makes a hospital tick because all too often their ignorance of those things is responsible for inefficiency and waste in many aspects of hospital function.

Chiefs of professional services have an important part to play in maintaining contact both with other professional medical services and with ancillary services. At a weekly staff seminar, say of the medical service, a representative of the laboratory, of the x-ray department, and of such other departments as current items bring into the picture should always be present. That is the best way to discover troubles in their beginning. It also adds immeasurably to the value of the discussions and it insures the most efficient all-around cooperation.

A senior nurse should accompany the staff on ward rounds to report on observations made by her or by other nurses, to hear the discussion of cases and to transmit the information to her staff. It is only in such a way that the nursing service can reach its highest state of efficiency.

The importance of team work at professional levels is well known, and its implementation well established. The tumor conference is an excellent example of this fact. It is the means for insuring for the patient the best in diagnosis and treatment that the hospital affords, and it is the best practical school for the young physician, but this is true only if the chiefs of the clinical services, the pathologist, and the radiologist are invariably in attendance at each conference, and if all junior medical officers are obliged to attend. Another important example is the rehabilitation team. Rehabilitation is a relatively new term in military medicine, but its significance is old. The military physician has constantly in mind not just the curing of an illness or the healing of a wound, but the complete restoration of the patient to normal so that from the hospital he can be returned to full duty. It is only a single further step, in the case of those not returnable to full or limited duty, to prepare them for a return in civilian life to a gainful occupation that is in keeping with their residual handicaps. This task the service hospitals learned to perform during the recent war with a high degree of efficiency, and they have continued to do so since the war, not only in the military hospitals but also in those of the Veterans Administration.

In civilian hospitals this subject has received relatively little attention except in those institutions that are the last refuge of patients with chronic or incurable disease. Civilian general hospitals have placed their chief emphasis on the treatment of active disease, because in civilian life the patient's convalescence and his physical and mental readjustment take place mostly in his own home. Consequently during the period of active disease much valuable time is lost in civilian hospitals by the failure to give attention to the ultimate rehabilitation of the patient. We in nonfederal hospitals, especially in teaching institu-

tions, should turn to service hospitals for the many valuable lessons that have there been learned in this important field.

Service hospitals have several important advantages over civilian institutions in carrying out a rehabilitation program. It is possible to group in a few hospitals all the cases of a single type, to assign a staff with appropriate skills in that condition to those hospitals, and to equip them with all the things necessary to implement a complete rehabilitation program. Moreover, the service hospitals, through economic as well as military authority, have a degree of control over their patients that no civilian hospital can ever hope to exercise. Service centers for the blind, for the deaf, for amputees, and for those with certain neurologic and psychiatric conditions have been able to achieve a high average level of successful readjustment.

Certain basic principles must be observed to carry on a satisfactory rehabilitation program.

1. *Rehabilitation begins on the day a patient is admitted to the hospital.* If he presents a short acute condition from which recovery will be early and complete, no formal program of rehabilitation is needed, but the longer the condition is likely to last and the greater the probable eventual handicap, the more necessary is such a program and the sooner it should be started. When the need for rehabilitation is obvious on admission, for instance blindness, or deafness or loss of limb, the program must begin on the day of admission to the hospital. This decision is the responsibility of the ward medical officer.

2. *Teams of workers* must be established to carry out such programs. In addition to the medical officer in whose special field of interest the patient's basic defect lies there should be such additional members to round out the team as the condition calls for. A team could therefore be small (doctor, nurse, and dietitian to train the diabetic) or a highly complex group (for the blind, an individual attendant, a trainer in orientation, an instructor in braille, a psychiatrist, an educational officer, a social worker, a chaplain, and eventually such additional instructors as are needed for vocational and avocational training and adaptation).

3. It is, however, just as important that the diabetic patient's training begin as soon as possible after admission as it is for the blind patient. This, too, is the responsibility of the ward medical officer.

4. *Rehabilitation teams must meet regularly,* say once a week, to keep programs moving smoothly.

(I have used the word "team" repeatedly. From the viewpoint of the hospital administration, it has this important function: *it fixes responsibility.* What is everybody's business, in the end is nobody's business, and so is often done indifferently or not at all. The members of a team know what to do and do it well. Let me cite you an instance of the value of such a team. I wonder how many of you know how well the

oxygen therapy in oxygen tents is being carried out in your hospital? If you do not know, then I can assure you that it is probably being done badly. I have proved that point in a number of hospitals in this way: An analysis of the oxygen percentage inside such tents while routinely in use showed a concentration that 23 out of 25 times was under 30 percent, and often under 25 percent. Such oxygen therapy was treating only the doctor and the family, but certainly not the patient. Yet someone was paying for the oxygen which was flowing into the tent at a rate to insure a concentration of at least 38 percent. An oxygen therapy team consisting of a nurse and two hospital corpsmen solved the problem on my medical service at the U. S. Naval Hospital, Philadelphia, Pa., where there were up to 29 tents in use at a time, by making an oxygen analysis, requiring only 2 or 3 minutes at the bedside and costing only a small fraction of a cent, once every 12 hours and noting the result on a tag tied to the tent. Whenever an analysis showed less than 38 percent, the ward staff promptly sought for and corrected the cause: a tent not properly tucked in, an open zipper, a hole in the tent, a loose connection, no rubber draw sheet over the upper end of the mattress. If you now have no such control on oxygen therapy in your hospital, this one practical point will have justified my appearance before you.)

5. Each large general hospital must have a coordinating and activating person who shall have cognizance of all types of rehabilitation: *the rehabilitation officer.* He is the spark-plug of the set-up, and the success of the program depends in large measure on his interest, initiative, and leadership. He should have the assistance of a *rehabilitation committee* or *board,* whose members represent the chief educational and social as well as clinical departments. The rehabilitation committee should hold a regular weekly session, with planned agenda as well as time for free discussion.

A major responsibility for fostering cooperation and understanding between all hospital departments, lay as well as professional, rests on the *hospital administrator.* A weekly conference in the office of the commanding officer or the executive officer, that includes not only the chiefs of the medical professional services but also the chief nurse, the service corps representative, the heads of maintenance departments, the senior Red Cross or social worker, and the chaplain, is of inestimable value both in bringing about an appreciation of their several problems, and in expediting their solution. In 30 years spent in civilian hospitals, I have yet to hear of the first such conference attended by both lay and professional personnel. We are missing a valuable means for improving the efficiency and the economical operation of our hospitals.

I have mentioned several committees and staff meetings. When will there be time to do one's work? The point is well taken, for such meetings can multiply to the extent of becoming unmitigated nuisances. It

requires judgment on the part of the hospital administrator to keep the number of such meetings within reasonable bounds. He can also see to it that, when feasible, different members of the same department shall represent it on the several committees or teams. He can arrange the time and place of meetings to suit the convenience of the majority of those who need to attend. Above all, it is up to the presiding member to start the meeting at the exact minute assigned and to end it with equal promptness when the business at hand is finished or the closing time arrives, whichever is first. In my book that administrator ranks highest by whose arrival you can set your watch, be that at a committee meeting, or at meal time, or in the recreation hall for the movies. My most cordial dislike has been won by those who wasted my time when I was punctual and they were late.

Up to this point, improved professional relations have been credited only with consequent improvement in professional function. It should be pointed out that *coordinated research* is a most important by-product of such team work. The Supplement to the U. S. Naval Medical Bulletin in March 1946, with its 32 articles on various aspects of rehabilitation prepared under my editorship as Rehabilitation Officer of the U. S. Naval Hospital, Philadelphia, is evidence of that fact.

Service hospitals have an advantage over civilian institutions in that they can explore the possibilities of improved professional relations beyond the confines of a single hospital by correlated programs in even widely separated areas. There has begun in some of our larger cities a program of interhospital activities that has far-reaching possibilities. The use of combined purchasing of various supplies is effecting significant economies in hospital operation. An even more important cooperation at the professional level is being fostered in several cities by a local *hospital planning agency.*

When there are several hospitals in the same section of a large city, it is not necessary that each be prepared to offer the ultimate in every phase of medical service. A single complete department of bronchoesophagology will meet the endoscopic needs of the community. A children's hospital, by entering into a professional relationship with a large general hospital at no great distance, can replace the pediatric service of the latter while benefitting from other services such as irradiation therapy, neurosurgery, and complicated laboratory service which the larger institution possesses. Particularly, teaching hospitals can so draw into their orbit a number of outlying satellite hospitals and thereby be themselves expanded into a *medical center* that can give to its area a complete, balanced, and economical service and to medical students a better chance for clinical training. This principle is also applicable to groups of hospitals of the federal services located within reasonable distances of one another.

Finally, one might explore further the possibility of professional interrelationships between service hospitals and civilian hospitals in

the same areas. A good beginning has already been made in this regard in the staffing of certain hospitals of the Veterans Administration under the supervision of local deans' committees. In a few of these, medical students are now serving as clinical clerks. The residency training programs in many service hospitals have made liberal use of certified members of the staffs of neighboring civilian hospitals. Residents of some teaching hospitals have been rotated through Army hospitals to relieve personnel shortages and at the same time to gain valuable experience. It would seem logical for service hospitals to make use of highly specialized services available in adjacent civilian institutions, such as a tissue culture service, a virologic laboratory, a radiotherapist, and many others. In return, the service hospitals could offer clinical instruction in various fields of clinical medicine, such as tropical medicine, orthopedic and traumatic surgery, and those involved in groups of rehabilitation cases. Such instruction could be both at the graduate and the undergraduate level. I hope that the ever-improving professional relations between physicians in federal service hospitals and their colleagues in civilian institutions will pave the way for such an expanding cooperation, to the mutual advantage of the physicians and in the interest of an improved service to our patients.

Accomplishments of Naval Dental Research

Carl A. Schlack, *Captain, DC, U. S. N. (1)*

IN 1942, an article *(2)* appeared describing a plan for dental research that might be undertaken in the Navy. The divisions described at that time were: (1) that type of research which could be undertaken by dental officer personnel entirely on their own responsibility, without support, or review by the Bureau of Medicine and Surgery; (2) that in which the researcher might seek funds, material, and personnel from the Bureau of Medicine and Surgery; and (3) that in which qualified dental officers and assistants participate in a master project involving many facets or phases of study in a single investigation of naval dental importance.

Since that report, it has become possible for naval dental officers to be designated officially as "qualified for dental research" and as "dental research specialists"; a rating for enlisted personnel as "dental research assistants" has been established; and physical facilities for dental research have been constructed within naval medical research institutes. Since this broad program was first planned, over 100 naval dental research reports have appeared in scientific and naval publications, related directly or indirectly to dental research problems of naval importance.

In 1948, an article *(3)* appeared describing a scientific mission that included biometrics, epidemiology, oral pathology, oral bacteriology, oral biochemistry and nutrition, oral therapeutics, and prosthesis. A textbook of dental epidemiology and statistics has been drafted. Reports have appeared on surveys involving time requirements in dental treatment. Various universities have become interested in the problems of oral pathology, particularly those related to ionizing radiation phenomena as exhibited in oral tissues and fluids. Studies in oral bacteri-

(1) Dental Branch, Biological Sciences Division, Office of Naval Research, Washington, D. C.

(2) Schlack, C. A.: Essentials for dental research in the Navy. J. Dent. Ed. 7: 123-125, Dec. 1942.

(3) Schlack, C. A.: Five-year dental research program. Monthly Research Report, Office of Naval Research, Nav. ExOs P-434, 38-, 12-15, Oct. 1947 and Jan. 1948.

ology have been made relating to dental caries and to the role of oral tissues, fluids, and structures in air-, fluid-, and food- borne infections. A training program for personnel in dental histologic technic is contemplated because a scarcity of such persons has delayed many of the studies on the hard structures of the mouth.

In 1950 the program of dental research in the Navy was consolidated under four master projects:

1. *Oral standards for service entrance (diagnosis and prognosis)* which include (a) studies leading to scientific evaluation of a patient's oral health before entrance to the service, which may save considerable sums of money when future rehabilitation by prosthesis or operation and hospitalization with subsequent loss of man-hours becomes necessary; (b) development of electronic measuring devices to determine chewing efficiency in the absence of several teeth and in the presence of malocclusion, and histochemical means of early diagnosis of malignancies, which may permit screening, as unsuitable, the man who might become a nonservice-connected medical burden for the remainder of his life; and (c) development of methods of analyzing results of such studies.

2. *Oral clinical treatment procedures* which include studies of (a) dental caries, particularly in relation to its prevention; (b) oral rehabilitation during mobilization and the surgical treatment of war injuries; and (c) the materials used in dental treatment.

3. *Oral effects of ionizing radiations (detection and prognosis)* on (a) oral tissue; (b) fluid bacterial defense mechanisms as related to lethal and sublethal doses of ionizing radiations from any source and concomitant nutritional effects; (c) tools for contributory diagnostic and prognostic procedure to assist at least in screening casualties from an atomic explosion who are beyond hope of recovery from those who might be saved; and (d) nutritional factors that might influence resistance to ionizing radiations.

4. *The role of oral tissues, fluids, and structures in air-, fluid-, and food- borne infection (detection, protection, and prognosis)* including the (a) mechanical, (b) biochemical, and (c) bacteriologic screening and carrier effect of oral tissues, fluids, and structures.

Dental research projects falling into these categories are being supported by the Office of Naval Research (ONR) at civilian institutions, some of which are joint studies with the Navy. In coordination with this program the master dental research projects which have been organized within the Navy, and supported by the Bureau of Medicine and Surgery, are as follows: (1) oral medical research related to the modern combatant methods; (2) preventive oral medicine (epidemiology, diagnosis, and prognosis); and (3) technics and equipment for naval dental teaching and practice.

The annual report of naval dental research for the fiscal year 1950 reveals that at the Naval Medical Research Institute the Dental Division has shown that:

1. Oral effects of ionizing radiations include hemorrhages in the tongue, floor of the mouth, and mucosa of the hard palate. There were evidences of destruction of ameloblasts and halts in amelification differing from that seen ordinarily in hypoplasia produced by other means. It is still not certain whether the dental defects were caused by local effects of ionizing radiation on the developing tooth germ or whether indirectly by injuries to some of the endocrine glands associated with calcification such as the thyroids, the parathyroids, and the pituitary. This work was conducted on animals who received lethal and sublethal doses of ionizing radiations.

2. The weight of food intake, water intake, gains in weight, and male and female hormones of animals apparently had no effect on the production of dental caries in the strain of rodents developed by the Dental Division, Naval Medical Research Institute.

3. Bilateral symmetry of dental caries was observed in only about 70 percent of a series of carefully controlled rodents. This may influence the results obtained in application of various preventive measures in which the right or the left side of the mouth is used as a control.

4. Field tests on intraoral photographic apparatus designed to make records of dental arches for use in personnel identification have shown that a prototype apparatus is about ready for production.

5. A review of the dental literature shows that little scientific information is available on the defense mechanism of the oral cavity against airborne infections.

At Great Lakes Naval Training Center, the most effective antibiotic used locally in a dentifrice to prevent dental caries seemed to be penicillin as measured by lactobacillus counts. The use of the lactobacillus count for this purpose, however, was found to be rather inexact. Studies in oral fusospirochetosis (trench mouth) revealed that this disease is not as common as generally supposed when critical clinical criteria are applied in diagnosis.

Support given at Corpus Christi on the development of air abrasives as a means of tooth cavity preparation instead of the revolving burr did much to focus attention on this method of cavity preparation.

Other studies have revealed that temporomandibular joint disturbances may be caused by malocclusion.

A method has been devised whereby the change in oral flora may be measured when experimental animals are subject to controlled quantities of airborne infectious organisms inhaled over unit time.

960522 O - 51 - 6

Cold weather studies revealed no more than the usual dental pains associated with dental disease in patients exposed to arctic conditions. Dental medicaments, equipment, and instruments generally are not affected by cold, and breakage of glass containers caused by freezing of their liquid contents can be controlled by reducing the volume of liquid in the containers.

In the annual report of the Dental Branch, ONR, for 1950, the following progress has been reported:

The masticatory efficiency studies have reached a stage where field tests are indicated. The several electronic devices constructed have been used to measure chewing efficiency and forces and the factors influencing them. The results applied to naval dental problems promise a means for a more scientific appraisal of the denture needs of service personnel. Records so obtained should assist in evaluating future service-connected denture construction claims when such tooth replacement requirements may have existed prior to entrance in the service. It is estimated that a 20 percent reduction in denture construction may be effected by the use of such means.

Contributions have been made to methods of more accurate diagnosis of precancerous oral lesions.

Other studies have revealed that acid beverages might best be reduced at naval installations and a palatable milk drink substituted in order to reduce potential tooth destruction.

The commercial claims for efficacy in preventing caries by means of ammoniated toothpastes and powders have been shown to be exaggerated.

The strength of filling materials and other materials used in dentistry should be evaluated by clinical trial rather than laboratory control tests, which omit factors operating in a regular clinical practice. The results obtained have contributed to a more scientific procurement schedule.

Additional oral bacterial studies in germ-free animals have again shown that bacteria are necessary in the tooth decaying process. These methods should contribute to a more exact approach to the determination of what mechanisms are operating in tooth decay. Further studies have shown that bacteria placed in various tissue areas of the mouth are transferred to other tissue areas and disappear at different rates. These studies are contributing much to our understanding of what happens to germs which enter our mouth from the air, water, or food; how diseases spread from one person to another, and what diseases may be spread by way of the mouth.

Preliminary research on the oral effects of ionizing radiations indicate that some changes occur in saliva when subjected to x-rays in vitro.

Dental research conducted within the Navy by naval personnel, which represents pioneer investigation through studies of the oral tissues, fluids, and structures of naval recruits and experimental animals includes:

1. The direct study on the yearly increment of dental caries in adults, done aboard ships and found to be about 1.2 cavity per person per year.

2. Biostatistical analysis of influences of place of birth on the incidence of dental caries in adults; correlations of dental treatment needs and place of birth, income per capita and dental treatment needs, income per capita and treatment rendered, dental treatment needs and dentist distribution, dentist distribution and income per capita. The results showed that civilian dentists were not distributed according to the dental treatment needs of the population but according to their income per capita, and that those recruits who were born in locations where the income per capita was greatest, showed the greatest amount of dental treatment. Recruits born in the East, South Central, and West South Central Areas showed the fewest dental defects and those born in the New England and Middle Atlantic areas showed the most dental defects. A dentist man-hour requirement per person was calculated which figure may be used to determine the number of naval dentists required to render a *complete* dental treatment service based on real rather than estimated factors. This made it plain that there could never be a sufficient number of dentists available to render a complete dental service to all naval personnel if dental standards for entrance into the service are low or nonexistent and that some compromise would have to be reached on the amount and type of dental treatment the naval Dental Corps can be expected to render.

3. A study of mass dental treatment methods in adults.

4. A study of audio-visual as well as other improved educational methods for dental training.

5. Identification of naval personnel by inserting their names in the substance of the denture material and mass intraoral photography.

6. A study of the influences of vibration ordinarily encountered in propeller-driven aircraft and different barometric pressures on dental structures and their associated tissues; and factors operating in dental pain experienced in some aviators while flying at high altitudes, and its control.

7. Nutritional studies on rodents contributing to further knowledge on the effect of acid beverages, development of measurement means and factors influencing the reduction of such effects.

8. A study of the effects of gains in weight, quantity of diet, amount of water and the inclusion of endocrine substance in the diet on the incidence of dental caries in rodents, all of which are important in the standardization of factors operating in the production of dental caries

in rodents, specifically in that strain developed by the Naval Medical Research Institute, and the possible role of oral tissues, fluids, and structures in the detection and prognosis of biophysical influences such as irradiation, chemical substances, and other military combat methods.

9. Basic studies on a method of clinically determining the number of glands in the oral mucosa; keratinization of oral mucosa in specific areas by the technics of tissue smears and special staining developed by others; effect of simple drying of the oral mucosa by unsterile air blast on colony counts from such areas. If these studies, conducted in 1941 and 1942, had been continued, they would have contributed much to the present knowledge required on the bacterial defense mechanism of and predisposing factors operating in the mouth.

10. The first studies on the effect of human saliva on the cholera vibrio conducted in Egypt during the last cholera epidemic in which a trend was found in the possible use of saliva as a contributing index of the relative immunity and susceptibility of persons to cholera.

11. A search for improvements in dental prosthetic and oral surgical treatment procedure.

12. A study of dental equipment and office housing for specific naval purposes.

13. Standardization of organization in dental research laboratories within the Navy where more than one person is conducting oral medical research and the efforts of those trained in the various sciences are coordinated.

CONCLUSIONS

A coordinated drive has been organized to solve, or at least initiate studies in, many of the oral medical problems that have naval importance and excellent progress has been made in accomplishing the original plans for naval dental research.

Decompression Sickness

Report of Two Unusual Cases

Walter Welham, *Commander, MC, U. S. N. (1)*

Charles L. Waite, *Lieutenant, MC, U. S. N. R. (1)*

DECOMPRESSION sickness is a condition resulting from too rapid a decompression in a person exposed to increased air pressure. This rapid change in ambient pressure causes the formation of gas bubbles in the blood vessels and other body tissues resulting in an impairment of the circulation. When the diver is surrounded by air, most of these bubbles are of nitrogen. The obstruction thus formed can cause pain, mottling of the skin, weakness, asphyxia, paralysis, and even death. This condition is commonly encountered by naval deep-sea divers and aviators. Bert *(2)* experimentally producing decompression sickness in animals, found that the condition was caused by bubbles of gas forming in the tissues and that there was a definite relation between the location of the bubbles and the location of the clinical signs. Hill and Macleod *(3)* also demonstrated the formation of bubbles in the capillaries of the web of a frog's foot when these animals were rapidly decompressed from high atmospheric pressures. As a possible preventive of this formation of bubbles, Bert recommended a gradual and steady decompression, but this proved to be ineffective.

It remained for Boycott et al. *(4)* to provide the first successful method for safe decompression. This "stage" method, as it is called, was founded on the following scientific reasoning. Dives at depths greater than 33 feet of sea water (pressure of 2 g) are possible because inert nitrogen is absorbed by the body tissues and these tissues are able to hold excess nitrogen in supersaturation. If this were not so, any attempt at ascent by a diver would result in the immediate formation of bubbles

(1) Experimental Diving Unit, U. S. Naval Gun Factory, Washington, D. C.

(2) Bert, P.: La pression barometrique; recherches de physiologie experimentale. Paris, G. Masson, 1878, viii, pp. 1168 (English trans. Barometric Pressure, Researches in Experimental Physiology. Translated from the French by Mary Alice Hitchcock and Fred A. Hitchcock. College Book Co., Columbus, Ohio, 1943.

(3) Hill, L., and Macleod, J. J. R.: Caisson disease and diver's palsy; experimental study. J. Hygiene 3: 401-445, 1903.

(4) Boycott, A. E.; Damant, G. C. C.; and Haldane, J. S.: J. Hygiene 8: 242, 1908.

and serious decompression sickness would ensue. From the study of many clinical cases and some laboratory evidence, these investigators noted that when the excess atmospheric pressure did not exceed 2.25 g (41 feet), the diver or laboratory animal was completely immune from symptoms caused by bubble formation: That is to say, either the bubbles were sufficiently small to pass through the narrowest capillary or no bubbles formed.

Because the volume of nitrogen released when the total pressure is halved remains the same whether that total pressure be high or low (Henry's Law), Haldane postulated that it would be just as safe to diminish the pressure rapidly from 6 to 3 g as from 2 to 1 g. If this proved to be the case then a stage system of decompression using the 2:1 ratio could be safely used. With this method the diver could rid himself of excess nitrogen through his lungs at a far greater rate than if Bert's gradual method was used, with the added advantage of shorter decompression times. The theory of the 2:1 ratio was put to the test first using goats and then human subjects. These trials were successful and prompted Haldane to state: "There were no ill effects in a number of experiments, nor in subsequent trials at sea; and rapid decompression to half the absolute pressure is now the routine practice of divers and it is not known to have ever resulted in harm." *(4)*

The present U. S. Navy Standard Decompression Tables, calculated and proved by Yarbrough et al. *(5)*, are based on the 2:1 ratio and thousands of successful dives have been made using these tables as a guide. A 5 percent incidence of bends is expected even when they are used properly. Most of this 5 percent occur after dives at depths greater than 225 feet or at shallower depths for long periods of time. This latter type of dive is called a "saturation dive." Decompression sickness occasionally occurs following dives at depths greater than 225 feet because the limiting ratio of slower saturating tissues drops to 1.75:1 or lower *(5)*, and following the saturation dives because a large amount of gas has been absorbed even at the shallower depths when the diving time is prolonged. Van Der Aue *(6)*, while conducting experiments to determine the effect of exercise on the incidence of decompression sickness, subjected 8 divers to a depth of 33 feet for 24 hours. Four of these divers did no work and the other 4 worked and rested in alternate periods. None of these men developed any symptoms or signs of decompression sickness, but 2 of another group of 8 divers suffered from bends after diving to a depth of 35 feet for the same period of time. One of these was in the resting group and one was in the working group. Thousands of simulated submarine escapes from a depth of 100 feet have been made by men using the Momsen lung. None

(5) Yarbrough, O. D.: Calculation of decompression tables. Experimental Diving Unit, U. S. Naval Gun Factory, Washington, D. C., 1937.

(6) Van Der Aue, O. E.; Keller, R. J.; and Brinton, E. S.: Effects of exercise during decompression from increased barometric pressure on incidence of decompression sickness. E. D. U. Report No. 8-49, Mar. 1949. Experimental Diving Unit, Washington, D. C.

of these men suffered from bends. This ascent from a depth of 100 feet after a short exposure with no decompression time is based on figures derived from the 2:1 ratio and seems to further validate its efficacy.

Within the past 2 years at the Experimental Diving Unit there have been 2 cases of decompression sickness complicating dives, both of which were made at depths of less than 30 feet and for periods of less than 2 hours.

CASE REPORTS

Case 1.—A 21-year-old student diver, reported to the Diving School at 0200 on 21 September 1949, complaining of pain, weakness, and numbness of the right arm and shoulder and mottling of the right arm. The onset had been fairly sudden and had occurred 2 hours before he reported for treatment. He had made his last dive 36 hours prior to the onset of symptoms. This moderately heavy working dive was made at a depth of between 25 and 30 feet. Examination revealed some weakness of the right arm and mottling of the skin extending from the wrist to the shoulder. The patient was recompressed, and relief of all symptoms occurred at a depth of 20 feet. He was brought to the surface several minutes later and remained symptom free for 1 hour, then all of his symptoms returned. He was recompressed in accordance with Treatment Table 1 (Diving Manual) and was brought to the surface symptom free. There was no recurrence. He had made several dives in the previous week with proper decompression and had had no difficulties.

Case 2.—A 24-year-old student diver made a dive to a depth of about 27 feet for a period of 96 minutes while performing heavy work. About 7 hours after he returned to the surface, he noticed a sharp pain in his right wrist. Because of the shallow depth at which he had been diving, he did not associate this pain with decompression sickness. He applied hot soaks with no relief. He reported to the Diving School at 2230 and consulted a medical officer who recommended treatment by pressure. Complete relief was obtained at a depth of 56 feet and treatment was carried out in accordance with Treatment Table 1. The patient returned to the surface symptom free and was placed under observation. About 21 hours after initial treatment he again complained of pain in the wrist. This at first was thought to be a recurrence, but when he received no relief after 30 minutes at a depth of 165 feet, it became apparent that this was not the bends. After he was returned to the surface in accordance with Treatment Table 2, a complete re-examination was made and the diagnosis of possible tissue damage following decompression sickness was made. He was admitted to the U. S. Naval Hospital, Bethesda, Md., for diagnosis and treatment. Roentgenograms revealed no evidence of fracture and a diagnosis of sprain was made. After 14 days in the hospital he was discharged to duty symptom free.

Comment.—This patient undoubtedly had decompression sickness to begin with as shown by the dramatic initial relief under pressure.

The subsequent pain, at first thought to be a recurrence, was most likely a reaction to tissue damage incurred by the initial illness. The factors in favor of this diagnosis are failure to obtain relief within 30 minutes at a depth of 165 feet, augmentation of the pain under pressure, and the time of onset. The diagnosis of sprain made at the hospital is probably not entirely accumate. The symptoms and signs of tissue damage following the bends are similar to those of sprain.

DISCUSSION

Anyone who has been exposed to increased air pressures has excess gas in solution in the tissues and may, therefore, develop decompression sickness. In the shallow dives for short periods of time, as in the two cases reported, the probability is very slight, but, nevertheless, it can occur. Therefore, in treating anyone with clinical symptoms following exposure to increased air pressures, it is imperative that decompression sickness be considered in the differential diagnosis.

Liver Suture

Richard S. Silvis, *Captain, MC, U. S. N.*

ADEQUATE suture material for repair of lacerations of the liver is not available at present. Lacerating fragment wounds of the liver requiring definitive suturing are common in combat. The Korean conflict and the present international situation lend import to an injury that is comparatively rare in peacetime. Ribbon catgut was developed years ago by urologists for suture of the kidney. While admirable for this purpose, it is swaged on an atraumatic needle that is too small for the repair of most liver lacerations. The atraumatic needle provided is excellent for placing a running suture to close the superficial margins of the laceration, but does not permit approximation in the depths of the wound.

The only available needle of sufficient length with an eye large enough to permit the threading of ribbon catgut is the autopsy needle. By rounding the point, and grinding the cutting edges of this needle on an emery wheel, a needle well suited for suturing the liver is produced (fig. 1). The grinding process decreases the temper of the needle, thus enabling the surgeon to bend it manually to any curve required. This suture (1) permits rapid repair of a liver laceration, (2) allows adherence to the basic surgical principle of closing a laceration from its depths outward, (3) eliminates the possibility of the suture cutting through the liver, (4) insures firm closure of the defect and (5) accomplishes hemostasis. Simple interrupted, mattress and running sutures may be employed as indicated. An atraumatic ribbon catgut suture, swaged on the modified needle would be preferable and such should be produced and made available.

TECHNICAL CONSIDERATIONS

Methods of suturing liver lacerations in common use today require a mattress suture, with strips of muscle or fat in the bights of the suture. This process is time consuming. The segment of muscle or fat may be misplaced, dropped, or inadvertently discarded during the placing of the mattress suture. Furthermore it is technically difficult to place the muscle or fat in the bight of the suture when repairing a laceration high on the dome of the right lobe of the liver. The use of gelfoam, fibrin foam, or muscle in the depths of a laceration is an adjunct, but does not replace anatomic suture of the defect. Gauze packing is

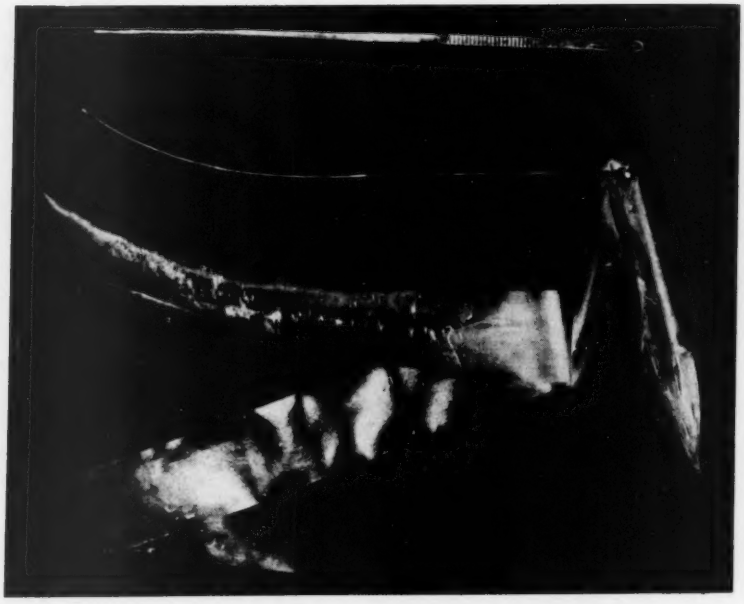


Figure 1.—Ribbon catgut threaded on autopsy needle.

mentioned only to condemn the procedure, although it may be lifesaving in extreme cases, particularly if ribbon catgut on a long needle is not available.

Massive hemorrhage from the liver during the repair may be greatly decreased by compression of the hepatic artery and portal vein. This is expeditiously performed if the first assistant places his left index finger in the foramen of Winslow, and compresses the vessels between his finger and thumb, thus providing an open field and freedom of motion for the operator. The repair of a deep laceration of the dome of the right lobe of the liver (the most frequent site of rupture caused by nonpenetrating trauma) is made technically easy by the use of a long needle holder, a long blunt needle and ribbon catgut. A left lobe hepatectomy is the procedure of choice in the event the left lobe of the liver is massively lacerated or crushed. The suture material shown is of value in elective operations. Its use in partial hepatectomy facilitates the repair and insures hemostasis. Drainage, preferably with one or more soft Penrose drains, is advocated following the repair of massive liver lacerations.

A summary of 16 case reports involving suture of the liver is shown in Table 1. Six of the 9 patients sustaining such major lacerations in combat incurred lacerations of other organs or viscera. A brief report

TABLE 1.—*Summary of 16 case reports involving suture of the liver**

Case	Age	Year	Place where injury occurred	Agent	Injury	Associated injury	Ribbon catgut used	Long needle used	Result
1	19	1945	Iwo Jima	Shell fragment	Laceration of right lobe, multiple	Perforation of colon	No	No	Recovered
2	21	1945	Iwo Jima	Shell fragment	Laceration of right lobe		No	No	Recovered
3	20	1945	Iwo Jima	Shell fragment	Laceration of left lobe	Perforation of jejunum	No	No	Recovered
4	24	1945	Iwo Jima	Shell fragment	Laceration of right lobe, multiple	Laceration of right kidney	No	No	Died
5	26	1945	Iwo Jima	Shell fragment	Laceration of right lobe	Laceration of right lung	No	No	Recovered
6	21	1945	Iwo Jima	Shell fragment	Laceration of left lobe	Perforation of stomach	No	No	Recovered
7	26	1946	San Diego, Calif.	Automobile	Rupture of right lobe		Yes	No	Recovered
8	28	1947	San Diego, Calif.	Automobile	Rupture of right lobe		Yes	No	Died
9	31	1947	San Diego, Calif.	Fall	Rupture of right lobe		Yes	No	Recovered
10	17	1948	San Diego, Calif.	Automobile	Rupture of right lobe	Contusion of right lung	Yes	No	Recovered
11	33	1948	San Diego, Calif.	Knife	Laceration of right lobe		Yes	No	Recovered
12	38	1949	St. Albans, N. Y.	Automobile	Rupture of right lobe		Yes	Yes	Recovered
13	43	1950	St. Albans, N. Y.	Tumor	Metastatic adenocarcinoma of left lobe		Yes	Yes	Recovered
14	23	1950	Kotori, Korea	Shell fragment	Laceration of right lobe		No	No	Recovered
15	21	1950	Kotori, Korea	Shell fragment	Laceration of right lobe, multiple	Laceration of gallbladder	No	No	Died
16	22	1950	Kotori, Korea	Shell fragment	Laceration of left lobe		No	No	Recovered

*Eleven patients with small lacerations of the liver, resulting from shell fragments or bullet wounds, which were repaired during more extensive abdominal procedures, are not included in this series.

of the patients who died, presented unusual problems, or illustrated certain technical points is presented.

CASE REPORTS

Case 4.—A 24-year-old marine was brought to the Division Hospital 4 hours after being wounded. He had received 16 mg. of morphine sulfate, and 500 cc. of plasma. Examination revealed intense pallor, a thready pulse of 132 per minute, and a blood pressure of 80/30. There was an irregular penetrating wound 3 cm. in diameter on the right flank, surrounded by numerous smaller fragment wounds. Two thousand cubic centimeters of whole blood was administered rapidly via the femoral veins. Under ether anesthesia a vertical transrectus incision was made in the right upper abdominal quadrant. The peritoneal cavity was filled with blood. The lacerated bleeding right lobe of the liver was temporarily packed. A right nephrectomy was performed because of a severely lacerated kidney. Repair of multiple deep lacerations of the right lobe of the liver was performed with mattress sutures of No. 0 chromic catgut, placing a portion of muscle in the bights of the suture. Fibrin foam was inserted into the lacerations prior to suture. A Penrose drain was placed beneath the liver and the abdominal incision was closed in layers.

An additional 3,000 cc. of whole blood was administered during the operation and the subsequent 24 hours. The patient recovered from shock, and was evacuated by boat on the second postoperative day in fair condition. The pulse was 90 and the blood pressure 116/70. On the sixth postoperative day severe shock recurred, and the patient died shortly thereafter. Postmortem examination revealed about 900 cc. of blood in the peritoneal cavity. The ligatures of the renal vessels were intact. There were thick blood clots over the right lobe of the liver, with evidence of recent hemorrhage.

Comment.—Although the lacerations of the liver were extensive this patient might have been saved had the suture shown in figure 1 been available.

Case 8.—A 28-year-old sailor entered a U. S. naval hospital 3 hours following an automobile accident. He was treated expectantly and symptomatically in an orthopedic ward for 20 hours, when signs of intraperitoneal hemorrhage became manifest. Following the administration of 500 cc. of whole blood, an operation was performed. The peritoneal cavity contained about 500 cc. of blood. There was a deep laceration 7 cm. long, running in an anteroposterior direction, over the dome of the right lobe of the liver. Fibrin foam was inserted into the depths of the laceration. Two mattress sutures of No. 0 chromic catgut were placed, with portions of muscle in the bights of the sutures, and tied. The superficial edges of the laceration were closed with ribbon catgut swaged on the small atraumatic kidney needle. Hemostasis was complete. The incision was closed in layers.

The patient made a rapid and uncomplicated recovery. The incision healed by primary union. By the tenth postoperative day he was asymptomatic. The erythrocyte count was 4,700,000. On the twenty-fifth postoperative day the patient complained of malaise and a dull pain over his right flank. Examination revealed no abnormal findings except that the temperature was 99.6° F. He was returned to bed, and treated symptomatically. During the ensuing week his symptoms and low grade fever persisted. His erythrocyte count was 4,600,000 and his leukocyte count 10,100. On the afternoon of the thirty-second postoperative day, while walking around his room, he suddenly became faint and collapsed.

Examination revealed the symptoms of severe shock. His pulse was 112. His blood pressure was 110/60. The abdomen was tender over the upper quadrant. One thousand cubic centimeters of whole blood was administered and an operation was performed 2 hours later. The peritoneal cavity contained about 800 cc. of fresh blood. Massive adhesions and organized and fresh blood clots extended over the dome of the right lobe of the liver. No definite point of hemorrhage could be seen. Fibrin foam was placed over the dome of the liver, and the abdominal incision was closed. Five hours postoperatively severe shock suddenly ensued and the patient died.

Postmortem examination revealed a hugh cavity 6 cm. in diameter in the right lobe of the liver, deep to the site of the old laceration. This cavity communicated directly with the hepatic vein, and was filled with fresh blood, cultures of which were negative. The previously sutured area over the cavity, representing a thickness of 2 cm. of liver tissue, was intact except for a small area at the posterior end of the laceration, through which the recent hemorrhage had occurred.

Comment.—This unusual case graphically illustrates the surgical principle that lacerations of the liver should be approximated anatomically from the depths to the surface. Ribbon catgut on a long needle would have made deep firm sutures possible, which might have prevented cavity formation, secondary hemorrhage, and death in this case.

Case 10.—A 17-year-old boy entered a U. S. naval hospital in severe shock, with a ruptured right liver and contusion of the right lung 1 hour following an automobile accident. Because of severe dyspnea and hemoptysis tracheal intubation and aspiration was performed. Continuous oxygen inhalation and 1,000 cc. of whole blood were administered. Operation was performed under local anesthesia, using intercostal block with 1 percent procaine. A linear laceration 5 cm. long on the dome of the right lobe of the liver was repaired, using mattress sutures of No. 0 chromic catgut with pieces of muscle in the bight of the suture. The superficial portion of the laceration was closed with a running suture of ribbon catgut swaged on an atraumatic kidney needle. The abdominal incision was closed in layers without drainage.

Convalescence was somewhat protracted, chiefly because of the contusion of the right lung, but by the twelfth postoperative day the patient was relatively asymptomatic. Roentgenographic examination revealed an elevation of the right hemidiaphragm, and atelectasis of the lower lobe of the right lung. During the ensuing week the right hemidiaphragm continued to rise, and a roentgenogram revealed findings consistent with subdiaphragmatic fluid in the right anterior suprahepatic space. An aspiration was performed through the fifth intercostal space in the midclavicular line, and 600 cc. of bile were aspirated. Cultures of the aspirated material were negative. Biweekly aspirations were performed, removing from 100 to 400 cc. of bile at each aspiration, for 2 weeks. The diaphragm returned to its normal level, the subdiaphragmatic cavity became occluded, and the patient's further convalescence was uneventful. He was discharged from the hospital on the fortieth postoperative day.

Sixth months later he re-entered the hospital complaining of colicky abdominal pain, nausea, and vomiting of 2 hours' duration. During the physical examination there were periodic attacks of excruciating pain which were associated with marked hyperperistalsis on auscultation. The attacks persisted for about 25 seconds, followed by a quiescent period of about 3 minutes, and then recurred. A laparotomy was performed, and a narrow adhesion which completely obstructed the jejunum 15 inches from the ligament of Treitz was severed. Massive adhesions existed throughout the right upper abdominal quadrant. The incision was closed. Convalescence was uneventful and the patient was discharged from the hospital on the ninth postoperative day.

Comment.—This case illustrates the desirability of placing drains to the area of sutured lacerations of the liver. Drains in this case would have prevented the accumulation of bile beneath the diaphragm. Furthermore the massive adhesions in the upper portion of the abdomen might have been caused by leakage of bile.

Case 13.—A 42-year-old sailor entered a U. S. naval hospital with adenocarcinoma of the rectum. A one-stage abdominoperineal proctectomy was performed. Abdominal exploration at the time of operation revealed a single firm, irregular, white nodule 1.5 cm. in diameter on the superior surface of the left lobe of the liver. Convalescence was uneventful. Pathologic examination of the specimen removed revealed a grade II adenocarcinoma involving one-third of the circumference of the rectum 3 inches from its terminus. The tumor extended into the submucosa. No metastases were found in the lymph nodes.

On the thirty-fifth postoperative day the left lobe of the liver was removed. A transverse incision was made 7 cm. above the umbilicus, transecting the left rectus muscle and the medial half of the right rectus muscle. The falciform ligament was divided. The triangular ligament of the left lobe of the liver was severed and the attachment of the falciform ligament to the diaphragm was divided. The left lobe of the liver was delivered forward. Using a long straight autopsy needle and

ribbon catgut, a row of mattress sutures were placed across the liver at the level of the falciform ligament, and tied securely. The left lobe of the liver was excised, during which procedure the blood loss was not over 10 cc. The left hepatic artery and left biliary duct were identified and ligated with No. 000 silk. The sectioned surface of the liver was brought together and covered with a running suture of ribbon catgut on an atraumatic kidney needle. Two Penrose drains were inserted and the incision was closed. Convalescence was uneventful. No drainage of blood or bile around the drains occurred.

Comment.—This case illustrates the advantage of using ribbon catgut in elective operations on the liver.

Case 15.—A 21-year-old marine entered D Medical Company Hospital 1 hour after sustaining a mortar shell wound. Examination revealed moderate shock. His pulse was 120. His blood pressure was 90/60. He had an irregular penetrating wound 4 cm. in diameter immediately beneath the right subcostal margin in the midclavicular line. One thousand cubic centimeters of whole blood was administered and operation was performed under nitrous oxide-oxygen-ether anesthesia. The peritoneal cavity contained about 1,000 cc. of blood. The entire anterior and lateral half of the right lobe of the liver was extensively lacerated. The fundus and two-thirds of the body of the gallbladder was lacerated. The lacerations of the liver were repaired with fibrin foam and repeated mattress sutures of No. 0 chromic catgut. Portions of fat and muscle were placed in the bights of most of the sutures. The task appeared hopeless and about 60 minutes were required for the suturing of the liver. A cholecystectomy was performed. At the conclusion of the operation hemostasis had been established, and the patient's blood pressure was 115/70. The incision was closed after placing two Penrose drains. The patient died of shock 5 hours after the operation.

Comment.—Ribbon catgut on a long needle would have decreased the time required for the actual suturing of the liver from 60 minutes to less than 15 minutes and would have permitted a firmer closure of the multiple lacerations.

CONCLUSION

The use of ribbon catgut on a long needle facilitates surgical repair of the liver.

Clinicopathologic Conference[1]

CAPTAIN W. J. SAYER: A 36-year-old white officer, previously in excellent health, was admitted to this hospital on 1 January with a diagnosis of a "gastrointestinal condition, acute, type undetermined." He was complaining of loss of 25 pounds in the previous 3 months; general weakness, intermittent dull aching pains in the calves of his legs, knees, and wrists of 1 month's duration; and mild, dull epigastric and substernal pains and anorexia of 4 days' duration. The epigastric and substernal pain was constant, poorly localized, did not radiate, came on immediately after eating, and was partially relieved in 15 to 30 minutes by taking some pills that were given to him by a local physician. His food habits were normal prior to his present illness. Eighteen months prior to admission he had developed hemorrhoids which bled occasionally. History pertaining to other systems was negative except for occasional headaches.

Physical examination revealed his temperature to be 100.2° F.; pulse 100; respirations 22; blood pressure 156/100. Murphy's sign (cessation of respiration when the fingers are pressed deeply into the right upper abdominal quadrant following forcible expiration) was slightly positive. Proctoscopic examination revealed no lesions except thrombotic external hemorrhoids. His abdomen was soft and slightly distended. Voluntary muscular rigidity was present over the upper portion of his abdomen. His liver and spleen were not palpable. A slight tenderness was present in his epigastrium and in his left lower abdominal quadrant. He appeared thin, emaciated, and markedly anemic.

On admission the red blood cell count was 3,450,000. The hemoglobin was 70 percent. The white blood cell count was 21,300 with 80 percent neutrophils, and 4 percent eosinophils. Three weeks later the red blood cell count was 3,890,000. The hemoglobin was 65 percent. The white blood cell count was 13,200 with 16 percent lymphocytes, 73 percent neutrophils, 9 percent eosinophils and 2 percent monocytes. The platelet count was 250,000. There were 0.8 percent reticulocytes. Red blood

(1) From the Walter Reed Army Hospital, Washington, D. C.

960522 O - 51 - 7

cell count showed slight polychromasia and slight achromia. Three weeks later the red blood cell count was 3,000,000, with 60 percent hemoglobin and the white blood cell count was 7,500 with 80 percent neutrophils, 14 percent lymphocytes and 6 percent eosinophils. The sedimentation rate was 30. The Kahn test was negative. The agglutination tests for *Salmonella typhi*, "O" and "H", and *Brucella abortus* were negative. A blood culture shortly after admission was negative. During the sixth week in the hospital the blood sugar was 135 mg. per 100 cc.; urea nitrogen 28.8 mg. per 100 cc.; potassium 17 and calcium 10.7 mg. per 100 cc. Urinalysis on admission showed one plus albumin with occasional red blood cells. Examinations during the second and fifth weeks showed about 12 red blood cells per high-power field and occasional granular and hyaline casts. The feces were positive for occult blood. The sputum was negative for acid-fast bacilli. The total acid values of gastric analysis were 35, 70, 60, and 70, and free HCl 25, 15, 40, and 50.

Barium enema, cholecystogram, and gastrointestinal series were negative. Roentgenograms of the chest 10 and again 17 days after admission were negative. One month after admission there was an advanced degree of pulmonary infiltration closely associated with truncal shadows, most marked in the hilar region. The process was evenly distributed throughout the lungs suggestive of a lymphogenous spread of a malignant process. The skull and pelvic bones were negative.

When the patient was first admitted the symptoms suggested avitaminosis and he was treated accordingly without benefit. He continued to lose weight and became weaker. Three weeks after admission he was noted to have a wrist drop in addition to marked weakness of the right leg and arm. He was found to have anesthesia of both feet and of the lower portion of his right leg. His right knee and ankle jerks were absent. A tentative diagnosis of peripheral neuritis was made. Five and a half weeks after admission he appeared dyspneic but was not cyanotic. At this time his temperature, pulse, and respirations were 98° F., 108, and 28 respectively. His blood pressure was 145/90. He developed a purpuric rash which disappeared on pressure and was most marked over the lateral aspect of his chest. Tactile fremitus became marked and his chest was hyperresonant anteriorly but some dullness was noted along the right vertebral margin at the level of his eighth rib. His breath sounds were loud, and there were coarse inspiratory rales in the upper portion of his left axilla and in the base of both lungs laterally. His heart sounds were faint, rapid and regular. He was placed in an oxygen tent. On the following day he developed signs and symptoms which were considered to be characteristic of an acute surgical condition within the abdomen. A roentgenogram showed free air under his diaphragm on the right side. An exploratory laparotomy was performed, a 3 mm. perforation in the lower ileum was repaired, the abdomen was drained, and the patient was given 500 cc. of blood. His postoperative course was progressively downhill and he died 23 hours after the operation.

On reviewing this patient's history it would be pertinent to know what drug therapy had been used, what diseases he had been exposed to, what his hobbies were, and where he had lived within the continental limits of the United States. The evidence would be suggestive if he had hunted or skinned rabbits, or if he had lived or visited in the San Joaquin Valley. The sudden onset of hemorrhoids 18 months prior to admission is suggestive of disease in the upper gastrointestinal tract. Perhaps the patient merely changed occupation and became more "bowel conscious." A 25-lb. weight loss in the 3 months prior to admission without other symptoms should direct immediate attention to the neoplastic, metabolic, infectious, and collagen diseases. The arthralgia with pains in the calves of the legs raises the question as to whether these symptoms were caused by primary organic disease at these sites, metastatic disease, or whether they were systemic or concomitant with general disease. For example these are common complaints in anemia and cachectic diseases.

In relation to the epigastric pain neither inciting factors nor relieving factors were noted except slight relief from use of "pills." This is of little help because no peptic ulcer has been cured, and very few helped, by the administration of pills alone. With definite evidence of gastrointestinal disease we should consider gastric malignancy and peptic ulcer. Although the familiar cycle of pain, food, and relief are typical of peptic ulcers, many patients give no history of such a cycle. In the absence of nausea, vomiting, dysphagia, hematemesis, and melena, and with pain alone as the presenting complaint, a cause other than peptic ulcer should be sought. Other possibilities are acute gastritis and a fairly infrequent pathologic entity, prolapse of the gastric mucosa through the pylorus. This is extremely difficult to demonstrate roentgenologically and the symptoms vary widely. The location and duration of the patient's vague headaches should be known.

As regards the physical findings it would be interesting to know how long this patient had his hypertension which may have accounted for his headaches. His vague abdominal tenderness substantiates the impression of gastrointestinal disease. The laboratory findings revealed progressive anemia which may be accounted for on the basis of bone marrow involvement or chronic bleeding. Blood indexes should have been obtained in this case, but (1) the lack of disparity between the red blood cell count and the hemoglobin, (2) the polychromasia, and (3) the hypochromia suggest an orderly red blood cell generation and helps to rule out primary bone marrow involvement or primary blood dyscrasia. Bone marrow studies would have settled this question. A persistent leukocytosis with elevation of the sedimentation rate, predominance of neutrophils even when the total count reached normal limits might indicate an infectious process or a cachectic state. An eosinophilia was noted and we should know whether this was maintained in later counts not reported in the protocol.

MAJOR JAMES L. HANSEN (2): Repeated counts showed a constant eosinophilia.

CAPTAIN SAYER: This directs our attention to allergic states, parasitic infections, and Hodgkin's disease. An agglutination test, for *Pasteurella tularensis,* and more than one blood culture should have been made. A blood sugar of 135 mg. per 100 cc., if at a fasting level and if not preceded by intravenous dextrose, is suggestive of pancreatic involvement. A glucose tolerance curve would have been of value, but the patient's condition at this time did not warrant such a study. A blood urea nitrogen of 28.8 mg. per 100 cc. is at the upper limit of normal but within the range of laboratory error. If repeated and found to be of the same level, it is suggestive of minimal urea nitrogen retention. The urinalyses showed a progressive albuminuria with occasional granular and hyaline casts and microscopic hematuria. Because all urines at this hospital are examined microscopically after centrifugation, the amount of hematuria here is significant. The specific gravities have been omitted but are necessary in evaluating renal function. I should have liked a Fishberg concentration test, at least as a prognostic aid. Addis' counts would have been of value and urea tolerance tests would have given more information as to the amount of renal involvement. In the presence of hypertension and in the absence of pyuria, the findings are suggestive of a diffuse glomerulonephritis of the type that follows streptococcal infections or scarlet fever. The occult blood in the feces may have come from meat in the patient's diet or from his hemorrhoids. The sputum was negative for acid-fast bacilli on several examinations. Were any gastric washings examined?

MAJOR HANSEN: Yes, and they were reported negative.

CAPTAIN SAYER: Intradermal tuberculin testing should have been done also. The roentgenographic findings were compatible with perivascular pneumonia in addition to being suggestive of lymphogenous spread of a malignant process. What chemotherapy was given?

MAJOR HANSEN: Sulfadiazine and penicillin.

CAPTAIN SAYER: The fact that symptomatic care and routine chemotherapy were ordered is to be highly criticized in any case, and particularly in this case in which the diagnosis was not clear. The routine administration of sulfonamides is becoming less frequent. The evils of routine chemotherapy are numerous and suffice it to say that only after careful bacteriologic studies is the administration of antibiotics justified. In any event the patient failed to respond to penicillin and sulfadiazine. The neurologic findings are consistant with peripheral neuritis or a diffuse and spotty involvement of the spinal cord. The chest findings indicate extensive consolidation. No mention was made of the type or amount of sputum raised. Heart sounds were

(2) Pathologist.

faint, rapid, and regular. The rales present in the base of both lungs could have resulted from the consolidation, the congestive failure, or both. The likelihood of the latter is great.

Paramount in considering this case as a whole, with the gastrointestinal, renal, pulmonary, central nervous system, and hematologic involvement, are the collagen diseases. With our better knowledge of the manifestations of this group of diseases, the ante-mortem diagnosis is being made much more frequently. In a symposium on periarteritis nodosa (3) 30 patients were studied from the renal, gastrointestinal, pulmonary, and neurologic viewpoints. In these patients some of the highlights of the renal aspects were: (1) no correlation between clinical evidence and the degree of pathologic change; (2) the development of hypertension without demonstrable pathologic change; (3) renal involvement was frequent and renal insufficiency alone was the cause of death in one-third of the patients studied. Seventy-six percent of the 30 patients had gastrointestinal symptoms; 69 percent had pathologic involvement of abdominal viscera. Eight of the 30 patients showed involvement of both the arterioles and the parenchyma of the lungs consisting of perivascular pneumonia or multiple diffuse granulomata and scarring. Peripheral neuritis occurred in 52 percent of the series. The average duration of the disease in those who developed peripheral neuritis was 5.3 months. Histologic data indicates that the degeneration of the peripheral nerves in this disease is entirely on a vascular occlusive basis. The close parallel between these 30 patients and the case under consideration inclines me to a diagnosis of periarteritis nodosa.

The sulfadiazine that this patient received may have aggravated his disease (4).

COLONEL VIRGIL H. CORNELL (5): Captain Alvord will discuss the neurologic findings in this case.

CAPTAIN ELLSWORTH C. ALVORD, JR.: This patient seemed to have had a peripheral neuritis involving both upper and lower extremities. It is convenient to divide peripheral neuritis into mononeuritis or polyneuritis. Mononeuritis is usually caused by a local factor such as a tumor, trauma, or pressure and is seen in such neuritides as sciatica, neuralgia parasthetica, Bell's palsy, "Saturday night palsy," and occasionally those associated with diphtheria or syphilis. Polyneuritis is usually caused by the allergic diseases, the collagen diseases, and the virus and toxic diseases. The most likely cause in this case is one of the collagen diseases involving the nutrient arteries of the peripheral nerves. In my opinion this is a case of periarteritis nodosa.

(3) Heck, F. J.; Ralston, D. E.; et al: Symposium on periarteritis nodosa. Proc. Staff Meet. Mayo Clin. 24: 17-52, Jan. 19, 1949.

(4) Gelfand, M. L., and Aronoff, S.: Periarteritis nodosa; possible relation to increased usage of sulfonamides. Ann. Int. Med. 30: 919-924, May 1949.

(5) Chief of Laboratory Service.

COLONEL CORNELL: I would like to have a representative of the Surgical Service discuss this case from the viewpoint of the patient as a surgical risk.

MAJOR CARL W HUGHES: Although this patient was definitely not a good surgical risk, he had a perforated viscus and had to be operated on as an emergency.

COLONEL PAUL S. FANCHER (6): Was there any reference in the report from the Mayo Clinic as to the frequency of perforation of the bowel in this disease?

CAPTAIN SAYER: Perforation of the ileum was noted in 6 percent of of the 30 cases. There was also one perforation of the gallbladder.

MAJOR LORENZ E. ZIMMERMAN (7): Today periarteritis nodosa is almost always diagnosed in clinicopathologic conferences which shows that we are all becoming aware of it. Lead poisoning and porphyrinuria should have been considered in this case. I would like to criticize the use of the term "collagen diseases" because although collagen is the matrix of fibroblasts, these are not the only elements affected in these diseases. Such tissues as muscle, bone, cartilage, synovium, vessels of all size, and the reticulo-endothelial system are likewise affected. In view of these facts, the term collagen disease is too confining because it singles out the matrix of only one cellular element affected in this group of diseases.

CAPTAIN SAYER: At the onset of the disease the multiplicity of symptoms suggested a diffuse vascular disease. In lead poisoning and porphyrinuria the combination of lung, blood, nerve, and renal involvement does not occur.

COLONEL CORNELL: The pathologist will give the postmortem findings.

MAJOR HANSEN: The autopsy revealed an emaciated, white man with a right rectus operative incision and a drainage incision with three rubber drains in the left lower abdominal quadrant. There was ulceration of the right great toe. The superficial cervical, axillary, and inguinal lymph nodes were large and palpable. The abdominal cavity contained 500 cc. of blue-gray creamy pus with generalized peritonitis. There was 400 cc. of fluid in each thoracic cavity and 200 cc. in the pericardium. The heart was grossly normal except for hyperemia about the coronary vessels. Microscopically there were scattered foci of inflammation involving the epicardium. About the vessels was fibrosis and inflammation which extended through part of the vessel wall. There was marked endothelial proliferation. The great vessels were arteriosclerotic and the lumbar aorta contained an ante-mortem thrombus. The left lung weighed 875 grams and the right lung weighed 825 grams.

(6) Chief of Medical Service.
(7) Laboratory Service.

Both lungs were congested, edematous, and had linear streaks of fibrosis. Microscopically all the fibrosis was about the arteries. The most severe changes were about and in the medium-sized arteries which were thickened with intimal proliferation and arteritis. The alveoli had become epithelized and contained pigment-laden macrophages. There were small areas of bronchopneumonia and occasionally suppurative bronchitis. The liver, pancreas, spleen, and adrenals were congested and covered with peritonitis. The vessels in these organs were similar to those previously mentioned. Each kidney weighed 200 grams. Numerous areas of ischemic infarcation, mainly in the cortex, varied from early degeneration to fibrosis. Some small arteries were occluded, others were thickened, others were recanalized, and some appeared to be small aneurysms surrounded by inflammatory changes. One pelvic artery was completely filled with thrombus. The other genitourinary organs were not remarkable except for the type of vascular changes already described.

The gastrointestinal tract contained numerous ulcers and small focal infarcts. The submucosal arteries and mesenteric arteries were segmentally thickened, nodular, and surrounded by perivascular infiltrate which varied from acute to chronic granulomatous inflammation. Arteries showed both partial and complete occlusion with and without thrombosis. An ulcer in the ileum had been surgically closed. The appendix was normal. The peritoneum was covered with a fibrinopurulent exudate. The lymph nodes revealed a reactive adenitis.

This is an acute or subacute inflammatory disease, the cause of which is unknown. The supposed relationship to syphilis is no longer accepted. Virus and bacteria have both been implicated, but in the past few years investigations and observations, chiefly by Rich (*8*), suggest that it is the result of an allergic vascular reaction. Periarteritis nodosa, also called polyarteritis and panarteritis, affects arteries of the medium size anywhere in the body, including the coronaries, which are estimated to be involved in as high as 70 percent of the cases. It is impossible to predict which vessels will show the lesions. The most characteristic pathologic change in periarteritis nodosa is the focal necrotizing inflammatory lesion with normal intervening segments of vessel wall. Arkin (*9*) has shown that the various organs of the body are affected as follows: kidneys 80 percent, heart 70 percent, liver 65 percent, gastrointestinal tract 50 percent, pancreas 25 percent, mesenteric artery 30 percent, muscles 30 percent, peripheral nerves 20 percent, and central nervous system 8 percent. The best description of the lesions observed is that of Ophuls (*10*).

(*8*) Rich, A. R., and Gregory, J. E.: Experimental demonstration that periarteritis nodosa is manifestation of hypersensitivity. Bull. Johns Hopkins Hosp. 72: 65-88, Feb. 1943.

(*9*) Arkin, A.: Clinical and pathological study of periarteritis nodosa; report of five cases, one histologically healed. Am. J. Path. 6: 401-426, July 1930.

(*10*) Ophuls, W.: Periarteritis acuta nodosa. Tr. Sect. Path. & Physiol., A. M. A. pp. 206-236, 1923; also in Arch. Int. Med. 32: 870-898, Dec. 1923.

The pathogenesis and the findings in the case presented are most adequately explained by such a process. To establish a diagnosis of periarteritis nodosa it is necessary to make use of all the signs and symptoms. Since peripheral neuritis is present in 50 percent of the cases, it is an important clue.

The anatomic diagnoses in this case were (1) periarteritis nodosa; (2) thrombosis, arterial of small intestines, spleen, and kidneys, secondary to periarteritis nodosa; (3) enteritis, ulcerative, with perforation and surgical repair, secondary to periarteritis nodosa; and (4) peritonitis, suppurative, generalized, secondary to ulcerative enteritis.

Concealed Delayed Hemorrhage

James T. Helsper, *Lieutenant, junior grade, MC, U. S. N. R.* (1)

Alfred O. Heldobler, *Major, MC, A. U. S.* (1)

Robert C. Anderson, *Lieutenant Colonel, MC, U. S. A.* (1)

RECENT spotlighting of war wounds and their care has brought to our attention some of the difficulties in their management. One interesting, and for a time puzzling, complication was concealed delayed hemorrhage. We have recently observed 3 patients with major hemorrhage in the leg which began as long as 4 months after the initial penetrating wound. Bleeding occurred beneath the deep fascia in the area of the interosseous membrane of the tibia and fibula in all three. The hemorrhage was enclosed within a fascial plane which did not communicate with the subcutaneous space or the outside. The most noticeable common factor in these patients, in addition to the symmetrical swelling, was excruciating pain which began soon after the hemorrhage started and was extremely resistant to all forms of narcotics. Patients described this pain as a feeling that the leg would burst and in this paper we have called it a distensile pain.

CASE REPORTS

Case 1.—A 25-year-old man was wounded on 27 July by a sniper bullet which entered the posterolateral aspect of his right leg just below the popliteal space and came out below the internal malleolus posteriorly. At the time, the patient noted profuse bleeding from the lower wound and it became necessary for him to apply a tourniquet. Débridement of the wounds of entrance and exit was done within a few hours. A plaster cast was applied and the patient was returned to the Zone of the Interior. Roentgenograms showed a markedly comminuted fracture of the tibia. About 4 months after the injury, long after the wound had healed, while the leg was still in a cast, the patient suddenly developed a severe, distensile aching pain in the midportion of his leg. Nothing unusual was found on physical or roentgenographic examination, and it was believed that the patient

(1) Madigan Army Hospital, Tacoma, Wash.

might have an early osteomyelitis. Antibiotics were given and he improved somewhat, but about 2 weeks later similar but more severe pain occurred, accompanied, this time, by marked swelling of his leg. The leg was explored by means of an anterior incision through the deep fascia which exposed about 1,000 cc. of clotted blood extending both anteriorly and posteriorly to the almost obliterated interosseous membrane. Following evacuation of the clot, and on release of the tourniquet, arterial bleeding occurred just posterior to the tibia, at about the junction of its middle and lower thirds. Closer inspection revealed a laceration of the posterior tibial artery about 1 cm. long. The artery was divided and doubly ligated. The wound was packed with vaseline gauze and closed 10 days later. There was no loss of the dorsalis pedis pulse following operation and no apparent reduction in circulation in the leg below the ligation.

Case 2.—A 20-year-old soldier was wounded on 23 September when a sniper bullet entered the medial side of his leg about 15 cm. below the knee and came out at the same level posterolaterally. At that time the patient noted only oozing from his wound. He was forced to crawl about 300 yards before initial aid could be obtained. Dressings were applied and he was sent back through evacuation channels to a hospital where a débridement was performed. A plaster cast was then applied and he was sent to the Zone of the Interior. Roentgenograms revealed a comminuted fracture of the midportion of the fibula with a small piece of metal near the fracture site. About 4 weeks following the injury, after the skin had completely healed, the patient began to note severe pain and swelling at the site of the injury. Suspecting an abscess, an attempt was made at drainage, but only a small amount of serous fluid was obtained. Moderate pain and swelling persisted and about 2 months after the initial injury the patient noted an increase of distensile pain and the swelling. The leg was explored and about 2 liters of clotted blood were found in the area between the tibia and fibula. These bones were spread apart and the interosseous membrane was obliterated. After evacuation of the clot and release of the tourniquet, a laceration 1 cm. long in the anterior tibial artery was found near the junction of the middle and upper thirds of the fibula. On applying pressure to the artery with the finger, a sharp piece of metal was encountered. It was removed and the artery was divided and doubly ligated. The wound was closed using 2 Penrose drains, which were removed 2 days later. There was some diminution of the dorsalis pedis pulse following the ligation but the circulation of the leg has been maintained.

Case 3.—A 30-year-old soldier was wounded on 6 December when a sniper bullet entered his right leg about 15 cm. above the medial malleolus and came out at the same level anterolaterally. There was very little bleeding at that time. The patient was able to walk painfully for about a mile. The wounds were débrided in an operating room, a cast

was applied to the extremity, and he was sent back to the Zone of the Interior. Roentgenograms showed a compound, comminuted fracture of the middle third of the right fibula. About 2 weeks following the initial injury, the patient began to complain of severe pain and swelling in the area of the wounds. He was taken to surgery and about 500 cc. of clotted blood was found in the area of the interosseous membrane. On evacuation of the clot and removal of the tourniquet, arterial bleeding was found just posterior to the tibia, at the junction of the lower and middle thirds. A sharp bony spicule had previously been palpated in this area. The fragment was removed and the artery was divided and doubly ligated. Following operation, there was some diminution of the dorsalis pedis pulse, but the circulation of the leg remained adequate.

DISCUSSION

Makins *(2)* stated that of the 10,000 patients with arterial injury that he reviewed, about 24 percent had secondary hemorrhage within 2 years following injury. Most of these occurred in open wounds. Crile *(3)* has described the diagnosis and management of this condition but did not say whether a local cause of the delayed arterial laceration, similar to the metallic fragment and bone spicule seen in two of our patients was found. Other reviewers *(4-7)* have stated that the secondary hemorrhage they observed occurred before the skin had healed. The only other report of patients similar to ours was made by Brown *(8)*. In one of his patients the profunda femoris artery and in another the popliteal artery ruptured after the wounds had healed causing hemorrhage confined beneath the deep fascia.

In our patients there was definite healing of the skin and deep fascia and the lacerated arteries were all beneath the deep fascia. In two of these a sharp fragment which could have caused the hemorrhage was palpated in the area of the laceration. The incidence of concealed secondary hemorrhages has probably been increased by early care and the use of antibiotics, which have promoted quick healing of the

(2) Makins, Sir G. H.: On Gunshot Injuries to the Blood-Vessels; founded on experience gained in France during the Great War, 1914-1918. John Wright and Sons, Ltd., Bristol, England, 1919.

(3) Crile, G., Jr.: Management of injuries of major blood vessels. U. S. Nav. M. Bull. 45: 1076-1080, Dec. 1945.

(4) Hermann, L. G.: Management of injuries to large blood vessels in wounds of violence. Am. J. Surg. 74: 560-575, Nov. 1947.

(5) Freeman, N. E.: Secondary hemorrhage arising from gunshot wounds of peripheral blood vessels. Ann. Surg. 122: 631-640, Oct. 1945.

(6) Rose, C. A.; Hess, O. W.; and Welch, C. S.: Vascular injuries of extremities in battle casualties. Ann. Surg. 123: 161-179, Feb. 1946.

(7) DeBakey, M. E., and Simeone, F. A.: Battle injuries of arteries in World War II; analysis of 2,471 cases. Ann. Surg. 123: 534-579, Apr. 1946; abstr., Bull. U. S. Army M. Dept. 5: 295-300, Mar. 1946.

(8) Brown, M. S.: Secondary hemorrhage following trauma to major blood vessels, Guthrie Cl. Bull. 17: 111-115, Jan. 1946.

wounds. Herrmann *(4)* and Crile *(3)* believed that these hemorrhages may result from the formation of a false aneurysm following a wound involving an artery, and rupture of the aneurysm on mobilization or manipulation of the affected extremity. Herrmann, however, stated that the most frequent cause for secondary hemorrhage, in the patients he observed, was persistent local infection which followed the initial wound.

Freeman *(5)* observed that secondary hemorrhage in 68 percent of his patients was associated with a compound fracture and that 67 percent had a history of massive hemorrhage following the initial injury. He also stated that in at least half of his patients a small initial hemorrhage preceded the massive hemorrhage by a few hours. This so-called "red warning" is an absolute indication for exploration. Another interesting observation which was borne out in our patients was made by Makins *(2)* who said that a laceration caused every case of secondary hemorrhage and that transection was never the cause because it allowed for retraction of the vessel and clotting of the blood.

TABLE 1.—*Differences between osteomyelitis and deep concealed hemorrhage*

	Osteomyelitis	Deep concealed hemorrhage
Onset	Usually gradual	Usually sudden
Temperature	Spiking	Low grade elevation
Pain	Varying	Distensile
Toxicity	Moderate	Minimal
Swelling	Usually localized on one side of extremity	Usually diffuse and symmetrical
Incision and drainage releases	Pus	Nothing unless carried beneath deep fascia, then clotted blood

Although in our three patients the circulation of the leg was maintained, DeBakey and Simeone *(7)* stated that 8.5 percent of the anterior tibial transections which occurred in World War II resulted in gangrene, and that transection of the posterior tibial artery had to be followed by some type of amputation in 13.6 percent of those on whom it was performed. In our 3 patients osteomyelitis was considered first as the most likely diagnosis. They were all given antibiotics and their temperature recorded every 4 hours. This diagnosis was abandoned because (1) of the lack of spiking temperature and toxicity; and (2) the pain and swelling were somewhat different from that usually seen in osteomyelitis. Table 1 gives the main points of use in differentiating secondary hemorrhage and osteomyelitis.

CONCLUSIONS

Modern methods of treatment probably increase the likelihood of the formation of concealed deep hemorrhage. following gunshot wounds.

When a tentative diagnosis of osteomyelitis becomes untenable and especially if symmetrical swelling and distensile pain are present, early exploration should be carried out, with a view to ruling out delayed concealed hemorrhage. Two possible results of delayed exploration are pressure necrosis of the muscles in the area or a break-through of the hemorrhage to the outside, causing possible exsanguination.

Pregnancy in the Right Side of a Double Uterus

George W. Markus, *First Lieutenant, U. S. A. F. (MC)* (1)

ALTHOUGH there have been several reports of pregnancies occurring in anomalous uteri in the past, the condition is rare enough that each new case should be reported. Anomalous conditions of the uterus, vagina, or both, can arise from failure of the mechanism of fusion or from failure of the disappearance of the septum anywhere along the juncture of the two original Muellerian ducts in the embryo.

Dionis, in 1681, and Saviard, in 1702, described anomalies of the type herein reported. The developmental processes involved in these conditions were first described by Mueller in 1830, but the mechanism was not fully understood until Kussmaul's work on this subject was published in 1859. The anomalous nature of these uteri when pregnancy occurs is too frequently discovered only at the time of delivery. For this reason the importance of a thorough prenatal examination cannot be overemphasized.

CASE REPORT

A well-developed white primipara was first seen at the end of the second trimester of pregnancy. She had no complaint. She had been under the prenatal care of another physician but had not had a pelvic examination. The physical findings were essentially normal except for the external and internal genital organs. Speculum and bimanual examination revealed a well-developed 5 mm.-thick vaginal septum extending the length of the vagina, from the double cervixes to the introitus. The hymen was perforated on both sides. The left canal was about 1 cm. smaller in diameter than that on the right, which easily admitted two fingers (fig. 1). The right cervix was slightly enlarged, soft, and boggy, but presented no other unusual features. The left cervix was small and firm.

Abdominal examination revealed an asymmetrical uterus with the pregnancy apparently in the right half and the left half not well-dif-

(1) Godman Air Force Base, Fort Knox, Ky.

Figure 1.—Speculum examination showing vaginal septum.

ferentiated but giving the impression of a smaller mass firmly attached to the body of the gravid portion of the uterus. The patient was unaware of the anomalous condition of her reproductive organs. She had had a normal onset of menses at the age of 14 years, a regular 30-day cycle, a flow of moderate amount, and no dysmenorrhea. No differences had been noticed in the periods from month to month. Her husband was unaware of the septum until the time of the pelvic examination.

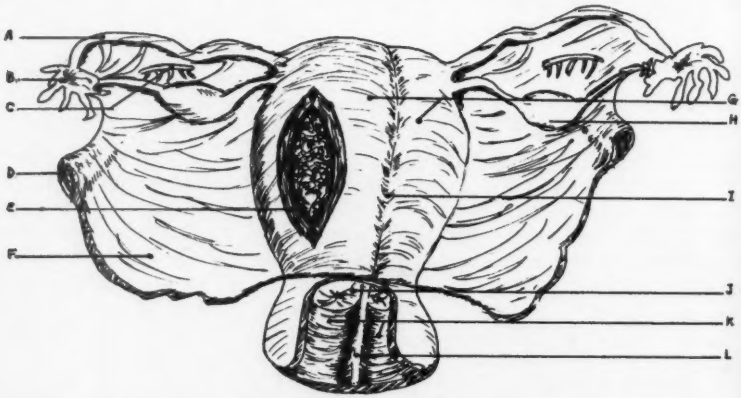


Figure 2.—Diagram of patient's uterus and adnexa as seen at time of cesarean section. (A) *Salpinx,* (B) *fimbria,* (C) *epoöphoron,* (D) *round ligament,* (E) *line of incision,* (F) *broad ligament,* (G) *double uterus,* (H) *ovary,* (I) *uterine septum,* (J) *double cervixes,* (K) *double vaginal canals,* (L) *vaginal septum. (Drawing by Capt. P. Quady, U. S. A. F.)*

Although the pelvic measurements were within normal limits cesarean section was advised as a means of preventing uterine rupture, prolonged first and second stages of labor, the probable impossibility of vaginal delivery, and the possibility of the infant not surviving an attempted normal birth. At term, after an uneventful prenatal course, the patient was delivered of a normal 7-pound 10-ounce infant by cesarean section. The placenta was normal and the postpartum course was uneventful. At operation, the uterus was double with a midline longitudinal depression showing the position of the intra-uterine septum, and with a fairly distinct separation at the fundus. There was one tube and one ovary attached to each half of the uterus (fig. 2). No other anomalies were found in the abdomen or pelvis.

The patient had a second pregnancy, delivered by cesarean section, in another part of the country about 1 year later. At that time, a tubal ligation was performed.

960522 O - 51 - 8

Amebiasis[1]

Evaluation of New Therapies

Ryle A. Radke, *Colonel, MC, U. S. A.* (2)

Since 1946 I have been concerned with the evaluation of quinacrine in the treatment of amebiasis. As a result of in vitro and in vivo studies conducted at this hospital, the conclusion was reached that quinacrine was a useful therapeutic agent in the management of amebiasis. In connection with this work it became evident that some additional agent should be combined with the quinacrine, and carbarsone was selected as being the most promising from the standpoint of eliminating the cystic stage of the causative organism in cultures. A number of patients have been treated with this combination of drugs (3, 4). When Conan (5) described the effect of chloroquine on the hepatic lesions of amebiasis and reported its relative ineffectiveness on the lesions in the bowel, my impression was that he had observed a phenomenon similar to the one which we observed with quinacrine, namely, that an additional agent capable of killing the cystic stage of the organism should be added. I have, therefore, treated a number of patients with chloroquine combined with carbarsone. Similarly a number of patients have been treated with aureomycin after the technic described by McVay et al. (6). A group of patients has been treated with a combination of quinacrine, carbarsone, and aureomycin. This last group was treated in this manner because of my conviction that the work of Hargreaves (7) with penicillin and sulfonamides could be confirmed with the substitution of aureomycin.

Materials and methods.—*Endamoeba histolytica* was demonstrated in material aspirated from rectosigmoidal lesions or in material aspi-

(1) Read before the American Society of Tropical Medicine, Savannah, Ga., November 1950.

(2) U. S. Army Hospital, Fort Knox, Ky.

(3) Radke, R. A.: Treatment of amebiasis with atabrine and carbarsone. (To be published.)

(4) Richardson, O. M.: Treatment of amebiasis with atabrine and carbarsone. Read before Muldraugh Hill Medical Society, Fort Knox, Ky., Aug. 1950.

(5) Conan, N. J., Jr.: Chloroquine in amebiasis. Am. J. Trop. Med. 28: 107-110, Jan. 1948.

(6) McVay, L. V.; Laird, R. L.; and Sprunt, D. H.: Treatment of amebiasis with aureomycin. South. M. J. 43: 308-313, Apr. 1950.

(7) Hargreaves, W. H.: Treatment of amoebiasis, with special reference to chronic amoebic dysentery. Quart. J. Med. 15: 1-23, Jan. 1946.

rated from the fecal stream in the absence of visible lesions in all patients in this series. All of them had a sigmoidoscopic examination immediately following treatment and again in from 30 to 90 days. At least 3 smears and a culture were taken before the bowel was presumed to be negative. Failure of the visible lesions to heal during treatment has been considered to indicate treatment failure in spite of negative smears and cultures. The dosage of quinacrine used was 0.1 gram 4 times daily for 15 days; of carbarsone, 0.25 gram 3 times daily for 10 days; of chloroquine, 0.25 gram 4 times daily for 15 days; of aureomycin, when used alone, 0.5 gram 4 times daily for 7 days; and of aureomycin used in combination with quinacrine and carbarsone, 0.25 gram twice daily for 5 days. When women and children were treated the dosage was proportionately less.

Thirty-five patients with amebiasis were treated with quinacrine and carbarsone; 38 with chloroquine and carbarsone; 33 with aureomycin alone; and 33 with an aureomycin, quinacrine, and carbarsone combination. Five patients included in the quinacrine-carbarsone group, 3 in the chloroquine-carbarsone group, 1 in the aureomycin group, and all of those in the aureomycin-quinacrine-carbarsone group had previously been treated unsuccessfully by other means.

TABLE 1.—*Comparative treatment failure rates*

Group	Treatment	Percent failures
1	Quinacrine and carbarsone	11
2	Chloroquine and carbarsone	78
3	Aureomycin	65
4	Aureomycin, quinacrine and carbarsone	12

Results and discussion.—The quinacrine-carbarsone group usually became symptom-free within the first 5 days of treatment. The complications were yellow discoloration of the skin in all patients, occasional nausea and vomiting which disappeared on discontinuing therapy and with bed rest, and which did not reappear when medication was again started. The failure rate was 11 percent (table 1).

The chloroquine-carbarsone group showed symptomatic improvement when it occurred as far as the bowel symptoms were concerned within from 5 to 7 days. The complications were a peculiar paresis of pupillary accommodation in almost every patient. This consisted in an ability to focus but an inability to hold the focus longer than a few seconds. In addition, most of the patients treated with these drugs had severe nausea and vomiting. This persisted as long as treatment was continued. In two patients these symptoms were so severe as to necessitate discontinuing the treatment. The failure rate was 78 percent.

The aureomycin-treated group showed symptomatic improvement of bowel symptoms, when it occurred, within 2 days. The complications were nausea, vomiting, and diarrhea in about half of the patients. These persisted as long as the drug was continued. One patient developed a rash which did not reappear when treatment with aureomycin was reinstituted after a rest period. The failure rate was 65 percent.

The aureomycin-quinacrine-carbarsone treated group usually showed improvement of bowel symptoms within the first 2 days of treatment. The complications were a drug rash in 1 patient and, as in the quinacrine-carbarsone group, a few patients complained of nausea and vomiting which disappeared when the drugs were discontinued and did not reappear when they were again administered in the same dosage. The failure rate was 12 percent.

The comparative failure rates suggest that amebiasis can be managed by a combination of quinacrine and carbarsone with the addition of aureomycin in severe cases and treatment-failures. I have data which suggests that quinacrine and carbarsone are amebacidal in vitro. Shaffer *(8)* found that vigorous 24-hour cultures of *E. histolytica* are inhibited by the addition of aureomycin to the culture in Shaffer-Frye medium, which, as he points out, suggests that aureomycin is amebacidal. He has also demonstrated an inhibitory effect of quinacrine on the growth of *E. histolytica* in concentrations of 58.8 micrograms per ml. *(9)*. The effect on the treatment success of adding aureomycin to quinacrine and carbarsone may be caused by a directly amebacidal action, as suggested by Shaffer's data, or may be a result of the effect of the drug on the bacteria of the bowel. The rapidity with which patients treated with this combination secure symptomatic relief suggests that some effect on the bacterial content occurs. One patient with hepatic abscess has been treated with quinacrine and carbarsone and 2 others, one with pleuropulmonary involvement *(10)*, have been treated with a quinacrine-aureomycin-carbarsone combination; all of them successfully and without surgical intervention, except for paracentesis in the pleuropulmonary case. These three patients are not included in the groups mentioned above because of the fact that the treatment was continued for a longer period than that employed in the less severe cases.

The usual patient with amebiasis whom we have treated can be managed either with quinacrine and carbarsone or with a quinacrine-

(8) Shaffer, J. G.: In vitro effect of aureomycin on cultures of Endamoeba histolytica and Trichomonas hominis II; disappearance of organisms from cultures treated with the antibiotic. (To be published.)

(9) Shaffer, J. G.: Personal communication.

(10) Radke, R. A.: Amebiasis with hepatic abscess and pleuropulmonary involvement. Armed Forces M. J. 2: 437-444, Mar. 1951.

aureomycin-carbarsone combination on an outpatient status. I have made it a rule to hospitalize those with hepatic involvement accompanied by fever, those whom I suspect will not take the drug unless supervised, and those with severe reactions to treatment. A blood count and urinalysis is made on each patient treated with carbarsone prior to starting treatment and the patient is instructed to report at once any untoward symptoms noted while taking the drug.

Craniotomies in Korea

Gale Clark, *Lieutenant Commander, MC, U. S. N. (1)*

THE purpose of this report is to enumerate the major problems encountered in primary craniotomies performed on this hospital ship from September 1950 to May 1951. The situation was unique in that a modern, well-equipped hospital was immediately available to freshly wounded men, and this was especially true of the operations at Inchon, Wonsan, and Hungnam. The operative mortality rate of only 14.2 percent was achieved because of the early availability of complete and up-to-date equipment which was ready for use as soon as the hospital ship arrived at the scene of action. Thus, 119 craniotomies and 14 craniectomies were performed on soldiers of many nations (table 1).

TABLE 1.—*Nationality of 123 patients undergoing cranial operations*

Nationality		*Number*
Chinese		2
English		3
French		2
Dutch		1
Korean		10
Filipino		1
Puerto Rican		1
Turkish		2
United States		101
Army	(67)	
Marine Corps	(31)	
Navy	(3)	

CRANIOPARANASAL SINUS WOUNDS

The operative management of these patients consisted of sinusotomy and craniotomy. The sinusotomy consisted of: (1) removal of foreign material and fragments of the sinus wall, (2) curetting out all the mucosa of the involved sinus or sinuses, (3) plugging the sinonasal duct with bone wax to prevent postoperative pneumoencephalocele, and (4) packing the sinus cavity with traumatized muscle and covering it with fibrin foam soaked in penicillin solution. The craniotomy was

(1) U. S. S. *Consolation.*

performed to débride, cleanse, and achieve hemostasis in the brain and then to restore the watertight integrity of the dura.

The ward management consisted of giving 100,000 units of crystalline penicillin intramuscularly every 3 hours; 0.5 gram of streptomycin intramuscularly every 6 hours for 4 days; and 10 cc. (10,000 units) of a penicillin solution intrathecally every day. Early, it was believed that giving large doses of urea by mouth might "wet down" enough molecules of penicillin to carry the penicillin through the choroid plexus to combat the bacteria in the spinal fluid. This was soon found to be ineffective and was discontinued. Hydration, blood, and urine studies were made as indicated.

There were 21 patients with paranasal sinus involvement; 13 survived and made uneventful recoveries. They will not be discussed. Eight died but in only one of these was death caused solely by infection. He had a severe basilar meningitis in spite of the fact that he was getting penicillin and streptomycin intramuscularly and penicillin intrathecally. He was the only patient of this group who did not get sulfadiazine either intravenously or by mouth. Five of those who died also had transventricular wounds with bits of contaminated sinus wall blown into one or both lateral ventricles. The seventh patient suffered a concomitant severance of the Galen's vein and the eighth had two tears in the anterior third of his sagittal sinus.

TRANSVENTRICULAR WOUNDS

Operative management consisted of débridement and cleansing of the ventricle and missile tract, establishing hemostasis, and the instillation of about 10 cc. of dilute penicillin solution into the ventricle followed by a tight closure of the dura. Ward management consisted of the same vigorous antibiotic approach as previously outlined for cranio-paranasal sinus wounds.

There were 18 patients with transventricular wounds. Six made uneventful recoveries and will not be discussed. There were 6 patients in whom paranasal sinus material was blown into or through one or more ventricles. All of these 6 died in spite of satisfactory débridement, ventricular instillation of dilute penicillin solution, and strenuous systemic, intrathecal and intravenous antibiotic treatment. This was the most distressing group. Four of these patients died of uncontrollable ventriculitis and meningitis. The lack of control of their infection would seem to indicate that a daily intraventricular instillation of antibiotic through polyethylene tubing might be tried in order to provide maximal bacteriostatic effect. The cause of death in 2 of the 6 who died was disruption of vital neurologic centers.

Of the remaining 6 patients, 2 more died as a result of infection while the other 4 died subsequent to destruction of vital centers. One of these died before he could be operated on and at autopsy showed destructive lesions through the right frontal lobe and in both corpora

striata. Another died 3 weeks after operation in a "rear" area from meningitis. The missile had traveled through the frontal lobes from left to right, crossing both ventricles into the right temporal lobe. One Korean patient died 2 days after operation and had a metallic fragment in the mouth of the aqueduct of Sylvius. He had an unsuspected perforated gastric ulcer with peritonitis possibly resulting from his hypothalamic injury. One patient died 71 days after operation of an uncontrolled cerebritis and general deterioration subsequent to an almost complete hemispherectomy of the nondominant side. He had been fitted with a lucite calvarium and was treated with penicillin instillations daily through vitallium screw holes in the hard clear plastic cap. Another patient died 3 days after operation and at autopsy showed destruction of both corpora striata plus a blood cast of his fourth ventricle. The eighteenth patient died 5 days after operation and had suffered a wound from a missile whose course was through the whole right ventricle from the anterior to the occipital horn. At operation this wound was intermittently irrigated through the wound of entrance in the forehead and the wound of exit in the occiput in an effort to flush the ventricle clean. Following this 10 cc. of penicillin solution was instilled. In spite of this the patient died of ventriculitis.

MAJOR VENOUS SINUS INJURIES

A major venous sinus was involved in 11 patients. Operative management consisted of débridement of the adjacent brain wound and covering of the venous sinus defect by sewing either macerated muscle or fibrin foam over the sinus tear. Five of these patients made uneventful recoveries and will not be described. The sagittal sinus was involved in 8 patients; a lateral sinus in 2; and the Galen's vein was torn and thrombosed in 1. Of those with sagittal sinus involvement, 5 died. In 2 of these the sagittal sinus had been cut in two and thrombosed; 1 lived for 14 days and the other for 20 days after the sinus was noted to be completely occluded. One patient also had numerous thrombi in his brain stem which precluded survival even after his sagittal sinus was repaired. Another had massive destruction of the paranasal sinuses bilaterally associated with 2 tears of his sagittal sinus. He died with a severe bronchopneumonia and meningitis. The patient with the thrombosis of the great vein of Galen died 3 days after operation; he also had a transventricular wound from the left frontal lobe to the right occipital lobe with the missile coursing through the anterosuperior portion of the fornix.

BRAIN ABSCESS

In treating brain abscess the best response was from removal of the abscess area "en bloc," and then cauterizing the dura to the cortex and leaving the dura open. Into this cavity polyethylene tubing was placed and used for daily irrigation with a dilute penicillin solution for from 5 to 8 days. This was done in 8 of 10 patients with good results. Immediate closure of the dura over the resected area precluded any direct

treatment to the abscess area and was regrettable in 2 patients who developed severe meningitis 2 and 3 days after operation, respectively.

Because of erroneous concept entertained early, secondary craniotomies were performed to remove small bits of bone missed at the primary operation. These were thought to be abscessed but no bacteria could be grown from the bone fragments or surrounding necrotic material; and it is believed that these might better be called zones of liquefaction necrosis. The material in these lesions was dark brown or magenta in color but was evidently rendered bacteria-free with the help of the systemic and local antibiotic medication.

DURAL TRANSPLANTS

Dural transplants were required in 47 patients (40 percent). One of the major difficulties in these patients was the fact that the transplant was necessarily directly under the scalp incision. In most patients the direction of the scalp incision was predicated by the tear in the scalp made by the missile or missiles. The major objective in closing these wounds was to débride and to extend the scalp wounds adequately so that a maximum blood supply to the flap would remain and allow for subsequent prompt healing. Consequently, the dural transplant would be under an edematous scalp sometimes closed under tension. Another distressing situation arose when large areas of scalp, skull, and dura were completely avulsed In these patients autogenous fascial grafts always failed because of their rapid dehydration and the inanimate polyethylene film (although usually difficult to place accurately under the dura) was the material of choice. In most patients, however, fascial grafts from an uninvolved area of the head were satisfactory.

X-ray Cones from Shell Casings

Wilson R. Scott, *Captain, MC, U. S. A.* (1)

Every radiologist or x-ray technician has, at one time or another, needed a special type of radiographic cone with which to accomplish a desired result. It is possible that a standard type of cone for his machine could not readily be obtained, because of location or supply. It is for these radiologists and technicians that this article has been prepared in an effort to demonstrate a simple method of overcoming this obstacle. Military roentgenology is accomplished in remote corners of the world, as well as in the United States. The rapidly expanding facilities of the military forces cannot always keep up with the supply of specialized equipment. In these radiographic or therapy departments, this method will be of the greatest aid in getting better results until a commercial cone is available. Excellent cones can be made of shell casings and metal scrap obtainable from almost any ordnance unit. The items are available in almost any size required. Table 1 gives the measurements of the standard shell casings used.

After the selection of a shell casing which meets the required measurements, the base of the casing is removed, leaving a metal tube of desired length. If a machine shop is available, the base is easily removed on a lathe; otherwise an excellent job can be done with a simple hack saw. The end is then squared. A base of the dimensions required to fit the x-ray tube head is prepared from available scrap, preferably 3/32 inch thick. A circular hole is then made in this piece of metal to accomodate the end of the casing. If brass has been selected for the base plate, the base and casing may be brazed or soldered. If welding facilities are available so much the better. Except for painting or polishing, the completed cone is now ready to go into service. (fig. 1).

Diagnostic departments will find the larger-size shell casings to be of greater use. These sizes can be used for examinations of gallbladders, skulls, mastoid processes, sinuses, and other special projections. Therapy departments will find an almost unlimited variety of

(1) U. S. Army Hospital, Camp Pickett, Va.

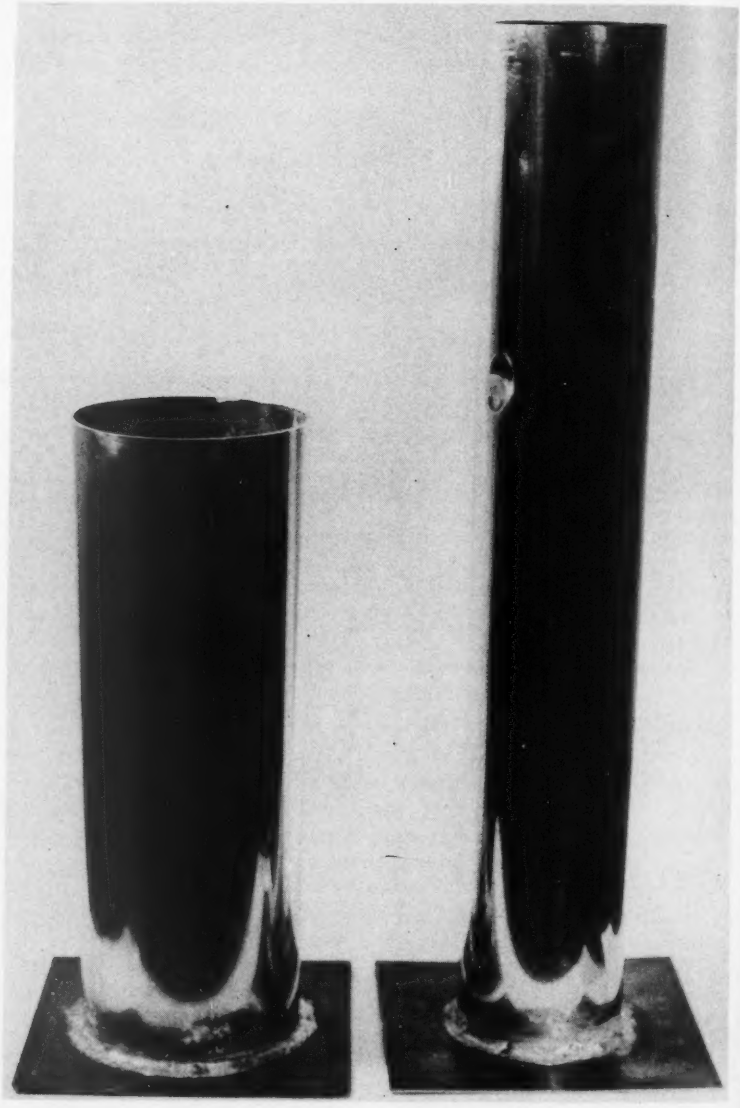


Figure 1.

TABLE 1.—*Standard shell-casing sizes.*

Ammunition (millimeter)	Approximate outside diameter (inches)	Approximate length (inches)	Cartridge case	Adaptability for cones
20	1 1/8	4.34	M 21-A 1	Therapy
37	1 9/16	5.69 8.75	MK 3-A 2 & MK 1-A 2-M 17 & M 16	Therapy
40	1 11/16	12.24	M 25	Therapy
57	2 5/16	17.4	M 23-A 2	Therapy or radiography
75	3 3/16	13.8	M 18	Radiography
76	3 3/16	21.0	M 26	Radiography
90	3 11/16	23.7	M 19	Radiography
105	4 5/16	14.6	M 14	Radiography
120	6 5/16	32.8	M 24	Radiography

casings which can be used for treatment of lesions of varying size. I have used equipment of this type for many months and have found that there is little or no difference in the results obtained with it and those obtained with standard cones.

Portable Field and Aircraft Inhalator

Russell G. Witwer, *Commander, MC, U. S. N. (1)*
Joseph E. Ganci, *Master Sergeant, U. S .M. C. (1)*
Harold B. Wright, *Chief Hospital Corpsman, U. S. N. (1)*

THERE has long been a need for a simple, easily constructed, and inexpensive oxygen-carbon dioxide inhalator among the Marine Air Groups. In view of the ever-changing requirements for breathing apparatus used in high-altitude flying, much surplus and obsolete equipment is available for the construction of such an inhalator.

The 9 by 14 by 24 inch box shown in figure 1A is made of half hard aluminum, and is light in weight. The total weight is 45 pounds, as compared to the 57½-pound weight of the standard (H&H) inhalator. Its small size gives it an added advantage for storage aboard a plane, ship, or on maneuvers. This box is divided into two compartments (fig. 1B). One contains a platform on which the oxygen regulator is placed. The portable oxygen bottle fits snugly beneath this platform. The remainder of this compartment contains 4 masks for use with the main cylinder, and 1 mask for the portable oxygen bottle. The larger compartment contains the 600-liter standard aviator's oxygen cylinder, with connections for 4 masks. A small tool kit is located on the regulator platform. Two brackets with wing nuts and bolts hold the large container in position, and may be quickly and easily removed.

The red knob on the regulator has been so marked as to indicate a flow of 10 liters per minute if pressure breathing is desired, and the amount of remaining oxygen is constantly indicated on the oxygen cylinder pressure dial. Masks are easily attached with oxygen automatic assembly couplings (AN–6009–2) as shown in figure 2. The inhalator may be used on from 1 to 4 patients simultaneously (fig. 3). The bail-out bottle serves a dual purpose. In the event of oxygen exhaustion from the large cylinder, it may be used as a supplemental source of oxygen while the cylinder is being replaced. The change-over can easily be made in 2 minutes, and the portable oxygen bottle contains a minimum of 5 minutes' supply. The bail-out bottle may also be used in an emergency as a fifth inhalator.

---

(1) U. S. Marine Corps Air Station, Cherry Point, N. C.

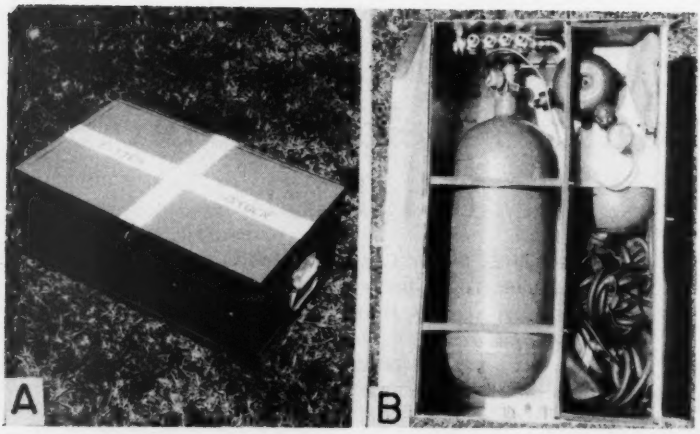


Figure 1.—(A) *Inhalator case closed.* (B) *Inhalator case open.*

Figure 2.—*Inhalator showing oxygen automatic assembly couplings.*

The old type dilutor-demand oxygen regulator (AN–6004–1) used with this apparatus is very satisfactory. The masks used are the old style free-flow Army oxygen masks. The portable oxygen cylinder is the old type Army cylinder with an A14 dilutor-demand mask. These parts are seldom if ever used. The standard aviator's oxygen cylinder is readily available. The advantages of this apparatus are the fact

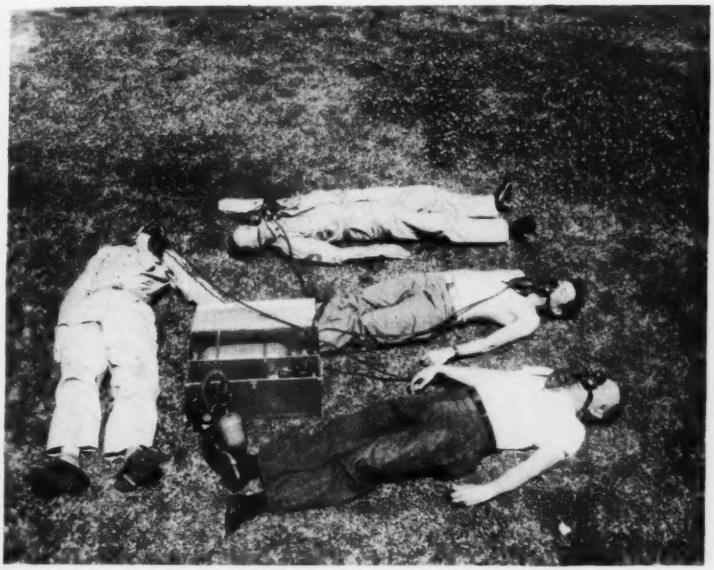


Figure 3.—Four patients using inhalator at one time.

that (1) it is easy to construct and is made from parts readily available at all air stations; (2) it is light in weight, and small in size, requiring a minimum of storage space; (3) anyone can be taught its use with a minimum of instruction; (4) it is inexpensive, practically all parts used being surplus or discarded materials; (5) the standard oxygen cylinder contains a much greater supply of oxygen than the conventional type; (6) it can be used on four patients simultaneously; (7) the oxygen flow can be regulated for either dilutor-demand or positive pressure as required (the amount of remaining oxygen in the cylinder is always known); and (8) the cylinder can be quickly replaced when the oxygen supply becomes exhausted, and the portable oxygen bottle affords an uninterrupted supply while the change is being made.

It is believed that this inhalator would be of great value in emergencies aboard ships, transport planes, and especially on a beachhead or in the field.

960522 O - 51 - 9

Bacitracin and Gelfoam

Combined Use in Dentistry

Albert D. Alexander, *Commander, DC, U. S. N. R.*

THE PURPOSE of this article is to invite attention to the value of gelfoam impregnated with bacitracin in the postextraction wound. The particular reference to its efficacy in oral surgery should not minimize its potentialities in other fields such as neurosurgery (1-3), otorhinolaryngology (4), and thoracic surgery (5).

Hemorrhage and infection are the two major complications of dental extractions. The incidence of these complications and the associated discomfort of the patient may be reduced by simple preventive therapy. The rationale includes the use of an absorbable gelatin sponge to control bleeding, to obliterate "dead space," and to promote healing by furnishing an aid in clot scaffolding. By combining a locally acting antibiotic with gelfoam, infection can be prevented. Bacitracin was selected because of its wide-range local antibiotic activity, in addition to the fact that no enzyme has been demonstrated in vivo which inactivates it.

"Gelfoam is a sterile, pliable, nonantigenic, surgical sponge capable of absorbing and holding within its meshes many times its weight of whole blood. When implanted in tissues it is completely absorbed in from four to six weeks without inducing excessive scar tissue formation. It is prepared from specially treated and purified gelatin solution which is beaten to the desired porosity, dried, sectioned, packed in jars, sterilized by dry heat, and the jar sealed to assure sterility of contents." (6) The investigations of Correll, et al. (7) indicated that

---

(1) Fincher, E. F.: Further uses of gelatin foam in neurosurgery. J. Neurosurg. 4: 97-104, Mar. 1947.

(2) Light, R. U., and Prentice, H. P.: Surgical investigation of new absorbable sponge derived from gelatin for use in hemostasis. J. Neurosurg. 2: 435-455, Sept. 1945.

(3) Light, R. U.: Hemostasis in neurosurgery. J. Neurosurg. 2: 414-434, Sept. 1945.

(4) Cope, B. A., and Hipskind, M. M.: Use of new agents in treatment of epistaxis. Eye, Ear, Nose & Throat Monthly 26: 417-419, Aug. 1947.

(5) Weisel, W.; Ross, W. B.; and Lubitz, J. M.: Behavior of gelatin film in human tissue and as aid in repair of pleural defects. Arch. Surg. 60: 87-91, Jan. 1950.

(6) Berg, L.: Gelfoam in dentistry. Dental Items of Interest 69: 3, 1947.

(7) Correll, J. T.; Prentice, H. R.; and Wise, E. C.: Biologic investigations of new absorbable sponge. Surg., Gynec. & Obst. 81: 585-589, Nov. 1945.

gelfoam was superior to fibrin foam and starch sponge with respect to absorbability in vivo. In addition, the histologic studies of these investigators revealed minimal foreign-body tissue reaction. Light and Prentice *(2)* using intracranial implants followed by microscopic studies revealed similar tissue tolerance for gelatin foam in addition to its excellent hemostatic qualities. Guralnick *(8)* and Berg *(6)* reported promising clinical observations on the prevention of postextraction hemorrhage. Both men hinted at the possible value of the addition of an antibiotic agent. Fincher *(1)* suggested the use of penicillin sponges in neurosurgery. Costich *(9)* used the dry sponge with the addition of thrombin to control hemorrhage. He reported no retardation of healing in 100 patients. Guralnick and Berg *(10)* in a study of 250 patients concluded that gelfoam represented a real advance in oral surgery. "Thrombin or penicillin showed no loss of potency from solutions in which absorbable gelatin sponges were suspended." *(11)* Silverman *(12)* compared results in 105 patients with 105 relative clinical controls, using gelatin sponge in a thrombin-penicillin solution. He noted a significant reduction in degree and incidence of postoperative pain and recommended widespread clinical trial.

Bacitracin is a product of the growth of the "Tracy I" strain of *Bacillus subtilis.* It was first reported by Johnson, Anker, and Meleney *(13).* After considerable laboratory investigation, Meleney and Johnston *(14)* issued the first clinical report based on local use in surgical infections. Bond et al. *(15)* in their studies on the stability of bacitracin found the dry powder quite stable over long periods at temperatures as high as 37° C.; and the aqueous solutions adjusted to a pH of from 5 to 7 with or without buffers stable for several months at refrigerator temperatures. Thus the solutions of bacitracin in concentrations sufficient for its topical efficacy can be made up and stored for ready use. The placing of gelfoam into the antibiotic solutions apparently does not alter the antibiotic efficiency of the latter or impair the hemostatic qualities of the former.

---

(8) Guralnick, W. C.: Absorbable gelatin sponge and thrombin in oral surgery. Am. J. Orthodontics (Oral Surg. Sect.) 32: 792-794, Dec. 1946.

(9) Costich, E. R.: Clinical use of gelatin sponge in dental surgery. New York State Dental Journal 13: 570-573, 1947.

(10) Guralnick, W. C., and Berg, L.: Gelfoam in oral surgery; report of 250 cases. Oral Surg., Oral Med. & Oral Path. 1: 632-639, July 1948.

(11) Correll, J. T., and Wise, E. C.: Stability of thrombin, penicillin, or streptomycin, in presence of gelatin sponge, oxidized cellulose or each other. Surg., Gynec. & Obst. 85: 211-213, Aug. 1947.

(12) Silverman, L. M.: Investigation of gelatin sponge with thrombin and penicillin in treatment of oral surgical wounds. Oral Surg., Oral Med., & Oral Path 2: 260-288, Feb. 1949.

(13) Johnson, B. A.; Anker, H.; and Meleney, F. L.: Bacitracin; new antibiotic produced by member of B. subtilis group. Science 102: 376-377, Oct. 12, 1945.

(14) Meleney, F. L., and Johnston, B.: Bacitracin therapy; first 100 cases of surgical infections treated locally with antibiotic. J. A. M. A. 133: 675-680, Mar. 8, 1947.

(15) Bond, G. C.; Himelick, R. E.; and Macdonald, L. H.: Stability of bacitracin. J. Am. Pharm. A., Scientific edition 38: 30-34, 1949.

The chief limitation of penicillin is its destruction by penicillinase. Bacitracin does not appear to be affected by the organisms that produce penicillinase. There have been no reports of local irritation or general toxicity by investigators. Resistance is slow to build up against bacitracin. Many organisms that are resistant to penicillin are susceptible to bacitracin. Its antibacterial spectrum is wide. Bacitracin is more effective against nonhemolytic streptococci than penicillin *(16)*. Moreover, it is active against many penicillin-resistant strains of staphylococci. It is not inactivated by the gram-negative rods that destroy penicillin. Its elimination from the body is slower. In mixed infections, therefore, bacitracin may be more effective than penicillin. In vitro studies have shown bacitracin to be effective against hemolytic streptococci, *Streptococcus viridans,* enterococci, and all strains of pneumococci.

Clinical trials were carried out using the antibiotic in sterile distilled water and in saline solution with procaine. It was found that the procaine solutions did not cause any apparent change in the properties of either gelfoam or bacitracin. For convenience, the procaine solution which comes in 2 cc. cartridge ampules was decided on in making up the bacitracin solution. Bacitracin may be obtained in 20 cc. vials supplying 2,000, 10,000, and 50,000 units. The 10,000-unit vial was found to be the most convenient. By adding 10 cc. of a 1, 2, or 4 percent solution of procaine to 10,000 units of bacitracin, a solution containing 1,000 units per cc. was obtained. This was found to be sufficient for the control of dental postextraction infection.

Preparation consists of adding bacitracin solution to cut pieces of gelfoam in the following manner: Gelfoam sticks are cut with scissors to the desired size of sponge required, one stick making about 10 sponges. The bacitracin solution is prepared by adding five 2-cc. cartridge ampules of procaine solution to the vial of 10,000 units of dry powder. The vial will hold 20 cc. and will allow plenty of space for the agitation and solution of the powder, which is readily soluble. The bacitracin solution is then placed into the gelfoam jar containing the cut pieces of sponge, saturating the sponges. The jar is kept in the refrigerator ready for use.

Clinical observations of over 1,000 patients has proved highly satisfactory. The clinical appearance of the postoperative wound together with the appreciation expressed by the patients is most gratifying. The simplicity and convenience of use in this form is striking. The operator simply lifts out one or more sponges and places them into the alveolar socket or defect. Sponges will remain in most sockets without mechanical aids. The gingiva may be sutured if desired. A sterile gauze pad is placed over the wound and biting pressure is applied by the patient. Larger defects resulting from cystectomies, tumor

(16) Meleney, F.: Treatment of surgical infections with antibiotic. Bull. U. S. Army Med. Dept. 8: 445-451, June 1948.

enucleations, et cetera should be packed completely before closure. The antibiotic activity of bacitracin will permit tight suture.

SUMMARY

Gelfoam is of aid in the control of postextraction hemorrhage, and is valuable in obliterating "dead space." Because it is completely absorbed, minimal scarring is produced. Gelfoam further aids healing by furnishing a clot matrix.

Bacitracin is an effective locally acting antibiotic agent particularly adaptable to oral use. The combination of gelfoam and bacitracin results in a product which embodies the desired qualities of both.

In the treatment of already established infections, bacteriologic evaluations are needed to identify the causative organism and thus indicate the proper antibiotic or other therapeutic treatment. No antibiotic is a substitute for good surgical technic.

Tularemia

Norris A. Wimberley, Jr., *Major, MC, U. S. A.*

AUREOMYCIN is the drug of choice in the treatment of acute tularemia. The optimal dosage is as yet unknown. Dagradi et al. (1), Taylor (2), and others have had almost uniformly good results in patients treated relatively late in the course of the disease. The following case report demonstrates the results of insufficient dosage of aureomycin, possibly used because treatment was instituted almost immediately at the onset of the disease.

CASE REPORT

A 33-year-old man was seen complaining of the sudden onset on the preceding evening of fatigue, generalized muscular aching, severe mental depression, a severe chill, a temperature of 104° F., and a severe bitemporal headache which was described as "expanding" in character. The history revealed that he had cleaned 22 rabbits 5 days prior to the onset and he and his family had eaten some of them. No other members of the family were ill.

Physical examination revealed a well developed man who appeared acutely ill. His temperature was 102.2° F.; his pulse was full and regular with a rate of 104. His cheeks were flushed and there was a mild conjunctival hyperemia (the mental depression was associated with crying). There was bilateral axillary adenopathy, more marked on the left, the nodes being nontender, freely movable, discrete and about the size of lima beans. His epitrochlear, cervical, and inguinal nodes were not palpable. His only skin lesion was a small crusted incised wound over the left ring finger, which occurred while he was cleaning one of the rabbits. The white blood cell count was 17,150 with 87 neutrophils, (including 7 stab and 2 juvenile forms) and 13 lymphocytes. The hemoglobin was 13 grams. A roentgenogram of the chest was negative. Agglutination tests for tularemia and brucellosis were reported as negative.

---

(1) Dagradi, A. E.; Sollod, N.; and Friedlander, J. H.: Treatment of tularemia with aureomycin. New York State J. Med. 50: 1970, Aug. 15, 1950.

(2) Taylor, R. R.: Report on tularemia; its diagnosis and treatment. J. Arkansas M. Soc. 47: 47-50, July 1950.

The possibility of acute tularemia could not be excluded and the patient was given an initial dose of 1 gram of aureomycin followed by 0.25 gram every 4 hours. His temperature remained near 102° F. through the night, despite the liberal use of aspirin in doses of 0.6 gram. The following afternoon it rose to 104.2° F. This was followed by profuse diaphoresis and subsidence of the temperature to 98.8° F. The patient slept comfortably through the night. His temperature remained normal for the next 2 days and all associated symptoms, with the exception of moderate fatigue, cleared. On the afternoon of the fourth day of illness mild bitemporal headache recurred but was unassociated with other symptoms. On the fifth day the patient was allowed out of bed, experiencing only mild "giddiness." The following day all medication was discontinued. He returned to work on the seventh day but experienced a sensation of chilliness and his temperature rose to 102° F. No frank chill occurred, This was again followed by profuse diaphoresis and return of his temperature to normal. He was again given 0.5 gram of aureomycin every 4 hours, omitting the 2 a. m. dose. This was continued for 9 days and during this period there was no fever and the patient experienced no symptoms with the exception of malaise for the first few days. No gastrointestinal or other side effects were noted. Aureomycin was again discontinued on the sixteenth day of the illness, the patient having returned to work several days previously. On the eighteenth day his temperature again rose to 102° F. and there was a moderate chill. He was given an initial dose of 0.5 gram of aureomycin, and 0.25 gram every 4 hours for 24 hours. No further medication was given. He responded in 24 hours and thereafter remained afebrile with the exception of an evening rise to 100.2° F. on the twenty-third day of illness. On the twentieth day it was reported that agglutination for tularemia in blood drawn on the sixteenth day was positive in a dilution of 1:320. Agglutination studies were reported as shown in table 1.

TABLE 1.—*Agglutination studies*

Day of illness	Antigen	Result	Dilution
2	Tularemia Brucellosis	Negative Negative	
16	Tularemia Brucellosis	Complete Negative	1:320
31	Tularemia Brucellosis	Complete Complete	1:1280 1:160
41	Tularemia	Complete	1:1280

DISCUSSION

Further history on this patient revealed that he had been rabbit hunting each week for 5 weeks preceding the onset of illness, but that 5 days prior to onset of the illness one rabbit had been caught by the dogs, possibly because it was ill. This rabbit was kept separate but was cleaned after some discussion. During cleaning it was noted that there were some spots on the animal's spleen but none on the liver. Because of this the animal was discarded but not before some of the peritoneal fluid had come in contact with the patient's skin, which he had previously incised over the left ring finger while cleaning another rabbit. Symptoms and fever were controlled within 24 hours of the institution of therapy and the typical cutaneous lesion did not develop but recurrence of fever and symptoms was not prevented by the dosage schedule employed, when discontinued. The drug proved no less effective when reinstituted on two occasions following recurrence of symptoms.

SUMMARY AND CONCLUSIONS

Treatment with aureomycin was instituted on the second day of illness of a man with tularemia. One gram of aureomycin as an initial dose followed by 0.25 gram every 4 hours for 4 days controlled symptoms within 24 hours and possibly prevented the development of the typical cutaneous lesion, but failed to prevent recurrence of symptoms when it was discontinued. No evidence of loss of effect resulting from resistance of the organism was noted on reinstitution of therapy after relapse. Half a gram of aureomycin every 4 hours with omission of the 2 a. m. dose for 9 days proved ineffective in preventing a recurrence of symptoms following discontinuation of medication, although the patient had been afebrile for 7 days, this dosage was sufficient to control symptoms within 24 hours when reinstituted on the ninth day of illness. Although aureomycin is generally agreed to be the drug of choice, the optimal dosage for tularemia has not been established. It is possible that in patients treated early in the course of the disease larger doses or longer periods of therapy will be required.

BOOKS RECEIVED

Roentgenologic Diagnosis of Diseases of Bones, by *David G. Pugh*, Assistant Professor of Radiology, Mayo Foundation, Graduate School, University of Minnesota; Consultant, Section on Roentgenology, the Mayo Clinic. 316 pages; illustrated. Thomas Nelson and Sons, New York, N. Y., publishers, 1951.

Bacteriological Technique, A Guide for Medical Laboratory Technicians, by *W. W. W. McEwen*, A. I. M. L. T., F. R. M. S., Bacteriologist, Messrs. Lantigen (Eng.) Ltd., Late Chief Technician and Lecturer in Bacteriology, Nottingham and District Technical College, Nottingham; with a foreword by Professor *Sir Alexander Fleming*, F. R. C. P., F. R. C. S., F. R. S. 293 pages; 70 illustrations. Chemical Publishing Co., Inc., Brooklyn, N. Y., publishers, 1950.

Diabetes Mellitus, Principles and Treatment, by *Garfield G. Duncan*, M. D., Clinical Professor of Medicine, Jefferson Medical College; Director of the Medical Divisions of the Pennsylvania Hospital and the Benjamin Franklin Clinic, Philadelphia, with the collaboration of *Ferdinand Fetter*, M. D., Assistant Professor of Medicine, University of Pennsylvania and Associate Physician to the Pennsylvania Hospital; *Perry S. MacNeal*, M. D., Associate in Medicine, Jefferson Medical College, Physician to the Pennsylvania Hospital and Associate in the Benjamin Franklin Clinic; *Barkley Beidleman*, M. D., Assistant in Medicine, Jefferson Medical College, Research Fellow and Assistant Physician to the Out-patient Department, Pennsylvania Hospital, and Associate in the Benjamin Franklin Clinic; and *Martha A. Hunscher*, B. S., Director of the Food Clinic, Pennsylvania Hospital. 289 pages; illustrated. W. B. Saunders Co., Philadelphia, Pa., publisher, 1951.

Electroencephalography in Clinical Practice, by *Robert S. Schwab*, M. D., Director of the Brain Wave Laboratory, Massachusetts General Hospital, and Associate in Neurology, Harvard Medical School. 195 pages; illustrated. W. B. Saunders Co., Philadelphia, Pa., publisher, 1951.

Patterns of Disease on a Basis of Physiologic Pathology, by *Frank L. Apperly*, M. A., M. D. (Oxford), D. Sc. (Melbourne), F. R. C. P. (London), Professor of Pathology, Medical College of Virginia, Richmond, Va. 456 pages; 50 figures and 37 charts. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1951.

History of Pharmacy, A Guide and a Survey, by *Edward Kremers*, Ph. G., Ph. M., Ph. D., Sc. D., Late Director, Course in Pharmacy and Professor of Pharmaceutical Chemistry, University of Wisconsin, and *George Urdang*, Ph. G., D. Sc. Nat., Sc. D., Professor of the History of Pharmacy, University of Wisconsin, and Director of the American Institute of the History of Pharmacy. 2d edition, revised and enlarged. 622 pages; 30 illustrations. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1951.

Pharmacognosy, The Study of Natural Drug Substances and Certain Allied Products, by *Robertson Pratt,* Ph. D., Associate Professor of Pharmacognosy and Plant Physiology, University of California College of Pharmacy, and *Heber W. Youngken, Jr.,* Ph. D., Associate Professor and Chairman for Pharmacognosy, University of Washington College of Pharmacy. 644 pages; 67 illustrations, including 4 plates in full color. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1951.

After the A Bomb? Emergency Care in Atomic Warfare, edited by *Charles F. Behrens,* M. D., Commanding Officer, Naval Medical Research Institute, National Naval Medical Center; Director, Atomic Defense Division, Bureau of Medicine and Surgery, Department of the Navy. 182 pages. Thomas Nelson & Sons, New York, N. Y., publisher, 1951. Price $2.50.

Report to the Combined Chiefs of Staff, by *The Supreme Allied Commander South-East Asia 1943-1945, Vice-Admiral The Earl Mountbatten of Burma,* K. G., P. C., G. C. S. I., G. C. V. O., K. C. B., D. S. O. 280 pages; illustrated. Philosophical Library, New York, N. Y., publisher, 1951. Price $12.

Physical Diagnosis, by *Raymond W. Brust,* A. B., M. D., F. A. C. P. Associate in Medicine, University of Pennsylvania Medical School. Introduction by *Truman G. Schnabel,* A. B., M. D., F. A. C. P. 294 pages; illustrated. Appleton-Century-Crofts, Inc., New York, N. Y., publisher, 1951. Price $4.50.

Pediatric Allergy, by *Robert Chobot,* M. D., Assistant Clinical Professor of Pediatrics, New York University-Bellevue Medical Center; Director of the Pediatric Allergy Clinic, University Hospital of New York University-Bellevue Medical Center; Consultant in Allergy, Downtown Medical Center; Assistant Physician, Allergy Clinic, Roosevelt Hospital. 284 pages; illustrated. McGraw-Hill Book Co., Inc., New York, N. Y. Price $4.50.

Clinical Unipolar Electrocardiography, by *Bernard S. Lipman,* A. B., M. D., Assistant in Medicine, Emory University School of Medicine, Atlanta, Ga.; and *Edward Massie,* A. B., M. D., F. A. C. P. Assistant Professor of Clinical Medicine, Washington University School of Medicine; Director of Heart Station, Barnes Hospital, St. Louis; Director, Cardiovascular Clinic, Washington University Clinics. 232 pages; illustrated. The Year Book Publishers, Inc., Chicago, Ill., publisher, 1951. Price $5.

Parasitic Infections in Man, edited by *Harry Most.* Symposium held at the New York Academy of Medicine, March 15 and 16, 1949. 229 pages; illustrated. Columbia University Press, New York, N. Y., publisher, 1951. Price $4.50.

Genetics in Ophthalmology, by *Arnold Sorsby,* Research Professor in Ophthalmology, Royal College of Surgeons and Royal Eye Hospital; Surgeon, Royal Eye Hospital, London. 265 pages; illustrated. The C. V. Mosby Co., St. Louis, Mo., publisher, 1951. Price $9.50.

Visceral Radiology, by *Emerik Markovits,* M. D. Formerly, Scientific Collaborator of the Central Radiologic Institute of the General Hospital (Holzknecht-Institute), Vienna; Head of the Radiologic Department of Elizabeth Hospital of the City of Budapest; Post-graduate Lecturer at the Central Radiologic Institute of the University of Budapest; Radiologist of the Steiner Clinic, Atlanta, Ga. 612 pages; illustrated. The Macmillan Co., New York, N. Y., publisher, 1951. Price $24.

The Physiology of the Newborn Infant, by *Clement A. Smith*, M. D. Associate Professor of Pediatrics, Boston Lying-in Hospital, Harvard Medical School. 365 pages; 52 illustrations. Charles C Thomas, Publisher, Springfield, Ill., 1951. Price $7.50.

Scoliosis, Pathology, Etiology, and Treatment, by *Samuel Kleinberg*, M. D., Attending Orthopedic Surgeon, Hospital for Joint Diseases; Consulting Orthopedic Surgeon, Lebanon Hospital, Maimonides Hospital, Hospital for Special Surgery, New York City; Lecturer in Orthopedics, New York University Medical School; Member, American Orthopedic Association; Member, American Academy of Orthopedic Surgery; Fellow, American College of Surgeons; Fellow, New York Academy of Medicine; Member, American Academy of Compensation Medicine. 286 pages; illustrated. The Williams & Wilkins Co., Baltimore, Md., publisher, 1951. Price $7.50.

Papain, by *M. L. Tainter, C. E. Alford, A. Arnold, H. Blumberg, O. H. Buchanan, E. T. Hinkel, Jr., K. Hwang, A. C. Ivy, R. K. Lager, J. R. Schmitz, J. R. Sheperd, H. S. Wyzan*, and *C. Zippin;* Editor, *Roy Waldo Miner*, Associate Editor, *B. J. Henegan*, Consulting Editor, *M. L. Tainter*. Annals of the New York Academy of Sciences, Volume 54, Art. 2, pages 143-296. 296 pages; illustrations. Annals of the New York Academy of Sciences, New York, N. Y., publisher, 1951. Price $3.

Anatomy in Surgery, by *Philip Thorek*, M. D., F. A. C. S., F. I. C. S., Assistant Clinical Professor of Surgery (Formerly Assigned to Gross and Topographic Anatomy), University of Illinois College of Medicine; Diplomate of the American Board of Surgery; Associate Professor of Topographic Anatomy and Clinical Surgery, Cook County Graduate School of Medicine; Member of the American Association of Anatomists; Fellow, American College of Chest Physicians; Co-surgeon in Chief of the American Hospital; Associate Attending Surgeon of the Cook County Hospital; Senior Attending Surgeon of the Alexian Brother's Hospital. 970 pages; 720 illustrations. J. B. Lippincott Co., Philadelphia, Pa., publisher, 1951, Price $22.50.

Diagnostic Methods in Veterinary Medicine, by *Geo. F. Boddie*, B. Sc. (Edin.), M. R. C. V. S., F. R. S. E., Professor of Medicine, Royal (Dick) Veterinary College, Edinburgh, with a chapter on Clinical Haematology by *H. H. Holman*, D. Sc., Ph. D., M. R. C. V. S., Pathologist, Agricultural Research Council's Field Station, Compton, Berkshire, and a chapter on Diagnosis of Poultry Diseases, by *J. G. Campbell*, F. R. C. V. S., Department of Poultry Diseases, Royal (Dick) Veterinary College, Edinburgh. 389 pages; illustrated. J. B. Lippincott Co., Philadelphia, Pa., publisher, 1951. Price $5.

Manual of Massage and Movements, by *Edith M. Prosser*, T. M. M. G., Trained Nurse and Certified Midwife. Member of Council of Chartered Society of Massage and Medical Gymnastics 1936-44; Sister in Charge Massage Department and Principal of School 1930-1949; continuing Examiner for Chartered Society of Physiotherapy at the Middlesex Hospital, London, since 1928. 388 pages; illustrated. J. B. Lippincott Co., Philadelphia, Pa., publisher, 1951. Price $6.

Diagnostic Standards and Classifications of Tuberculosis, 1950 edition. 64 pages. National Tuberculosis Association, New York, N. Y., publisher, 1950.

Transactions of the New York Academy of Sciences, March 1951. *Roy Waldo Miner*, Editor, and *B. J. Henegan*, Associate Editor. 186 pages. The York Academy of Sciences, New York, N. Y., publisher, March 1951. Price 50¢.

Surgical Pathology of the Mouth, by *E. Wilfred Fish*, C. B. E., M. D., Ch. B., L. D. S. (Manch.), D. D. Sc. (Melb.), D. Sc. (Lond.), F. D. S., R. C. S. (Eng.) (From the Meyerstein Laboratory for Dental Research, St. Mary's Hospital, Paddington, London), Dental Surgeon St. Mary's Hospital, London; Late Dental Surgeon Royal Dental Hospital, London; Hon. Research Associate in Physiology, University College, London; External Examiner in Oral Anatomy and Physiology, University of Durham; Late Examiner in Dental Surgery and Pathology, University of Manchester. 463 pages; illustrated. J. B. Lippincott Co., Philadelphia, Pa., publisher, 1951. Price $10.

Management of Celiac Disease, by *Sidney Valentine Haas*, M. D. Professor of Pediatrics and Director of the Department, New York Polyclinic Medical School and Hospital; Consultant, Lebanon Hospital, Harlem Hospital, and Riverside Hospital for Contagious Diseases of the New York Health Department; Fellow of the New York Academy of Medicine, and *Merrill Patterson Haas*, M. D. 188 pages; 12 illustrations. J. B. Lippincott Co., Philadelphia, Pa., publisher, 1951. Price $5.

Therapy of Dermatologic Disorders, Including a Guide to Diagnosis and a Dermatologic Pharmacopeia, by *Samuel M. Peck*, B. S., M. D., Dermatologist to the Mount Sinai Hospital, New York City; Associate Clinical Professor of Dermatology, Columbia University, New York City; Medical Director (R) Inactive U. S. P. H. S., and *George Klein*, M. D., Associate Visiting Dermatologist, Morrisania City Hospital, New York City; Acting Adjunct, Mount Sinai Hospital, New York City; Assistant Clinical Professor of Dermatology, New York Medical College. 383 pages. Lea & Febiger, Philadelphia, Pa., publishers, 1951. Price $6.50.

Diseases of the Endocrine Glands, by *Louis J. Soffer*, M. D., F. A. C. P., Associate Attending Physician and Head of the Endocrine Research Laboratory and Clinic, The Mount Sinai Hospital, New York City; Assistant Clinical Professor of Medicine, Columbia University. 1142 pages; 88 illustrations and 3 colored plates. Lea & Febiger, Philadelphia, Pa., publishers, 1951. Price $15.

Principles of Medical Statistics, by *A. Bradford Hill*, D. Sc., Ph. D., Professor of Medical Statistics in the University of London (London School of Hygiene and Tropical Medicine); Honorary Secretary of the Royal Statistical Society; Civil Consultant in Medical Statistics to the Royal Air Force; Member of the Internation Statistical Institute. 5th edition, revised and enlarged. 282 pages. Oxford University Press, New York, N. Y., publisher, 1950. Price $3.

Modern Dietetics, by *Doris Johnson*, B. S., M. S. Fellow in Home Economics, University of Wisconsin. Formerly Supervisor, Ward Dietary Service, The Presbyterian Hospital of the City of New York, and Instructor in Dietetics, Department of Nursing, College of Physicians and Surgeons, Columbia University. 529 pages; illustrated. G. P. Putnam's Sons, New York, N. Y., publisher, 1951.

Methods in Medical Research, Governing Board: *Irvine H. Page*, Chairman, *A. C. Ivy, Colin M. MacLeod, Carl F. Schmidt, Eugene A. Stead, David L. Thomson*, Vol. IV. *Maurice B. Visscher*, Editor-in-Chief; Histochemical Staining Methods, *George Gomori*, Editor; Fluid and Electrolyte Distribution, *Louis B. Flexner*, Editor; Studies on Gastrointestinal Pressures, Innervation and Secretions, *J. P. Quigley*, Editor; Tissue Culture Methods, *C. M. Pomerat*, Editor. 306 pages; illustrated. The Year Book Publishers, Inc., Chicago, Ill., 1951. Price $7.

BOOK REVIEWS

Progressive Resistance Exercise, Technic and Medical Application, by *Thomas L. DeLorme,* B. S., M. D., Assistant in Physical Medicine, Massachusetts General Hospital; Consultant in Physical Medicine, Long Island Hospital, Boston; and *Arthur L. Watkins,* A. B., M. D., Assistant Clinical Professor of Medicine, Harvard Medical School; Chief of Physical Medicine, Massachusetts General Hospital. Foreword by *Joseph S. Barr,* M. D. 245 pages; illustrated. Appleton-Century-Crofts, Inc., New York, N. Y., publishers, 1951. Price $5.

Progressive resistance exercise has been rather generally accepted by physicians and physical therapists as the best method of treatment for muscles weakened by disease or injury. In spite of this fact there are many times when the results from this treatment are disappointing. Usually this is because the technic of applying the principles of progressive resistance exercises is faulty. This book fills a great need in that the text and pictures give the reader detailed instruction in the best way to exercise various muscle groups. DeLorme has spent a great deal of time in devising equipment and technics for scientifically applying the principles of heavy resistance exercise to a variety of clinical entities. Although the chapter on physiology written by Hellerbrandt is not complete enough for a text of this type, it should stimulate the reader to investigate other aspects of the physiology of exercise.

The technics described have largely been devised for use on the Elgin exercise table. Many of the exercises can be adapted to improvised equipment but may thereby lose some of their effectiveness. Unfortunately the Elgin equipment is not available to all departments of physical medicine because of its cost. There are, however, enough illustrations of exercises which can be performed without this highly specialized equipment to make the book worthwhile. This monograph should be read by all physiatrists and physical therapists. The orthopedic surgeon, the neurologist, and the general practitioner could also read it to good advantage. Most of the book is written simply, in language easily understood by the physical therapist as well as by the physician. This book is of special interest to those of us in the Armed Services because it is essential that we return men to full duty as soon as possible with a minimum of disability from their disease or injury. There is no quicker method of improving muscle strength than with progressive resistance exercise, hence adoption of the principles outlined in this book to convalescent service men will give us a better, more efficient fighting force. In regards to the service man in training, it might be well to apply some of the principles of progressive resistance exercise for the purpose of conditioning him for tasks requiring physical stamina. In the light of our newer knowledge we should critically examine our physical training programs to see if we can condition our men more quickly thus allowing more time for other training.

—Maj. J. N. Schaeffer, U. S. A. F. (MC)

Paul Ehrlich, by *Martha Marquardt.* 255 pages; illustrated. Henry Schuman, Inc., New York, N. Y., publisher, 1950. Price $3.50.

This volume in the publisher's popular "Life of Science Library" is a biography of one of the greatest figures in the history of modern medicine. The discovery of the arsenical series of drugs and their specific effect in many spirochetal diseases of man and animals undoubtedly stimulated chemotherapeutic research, and led logically to the development of the sulfonamides and the antibiotics. Ehrlich is the great pioneer of modern chemotherapy and salvarsan, the "magic bullet" to slay syphilis, was the first of many such guided missiles against disease. Miss Marquardt was Dr. Ehrlich's secretary from 1902 until his death in 1915, and it is natural and most fortunate that she has given a fine portrait of so great a man. The illustrations are a most valuable feature of the book and it is gratifying to have them permanently preserved. The Royal Society of London has commissioned Miss Marquardt to collect and edit all of Ehrlich's scientific papers. This should be a most important contribution to the history of medicine.

—*Capt. L. H. Roddis, MC, U. S. N. (Ret.)*

Handbook of Medical Management, by *Milton Chatton*, A. B., M. D., Instructor in Medicine, University of California Medical School, San Francisco; *Sheldon Margen*, A. B., M. D., Clinical Instructor in Medicine, University of California Medical School, San Francisco; *Henry D. Brainerd*, A. B., M. D., Assistant Clinical Professor of Medicine and Pediatrics, University of California Medical School, San Francisco, Assistant Clinical Professor of Pediatrics, Stanford University School of Medicine, Physician in Charge, Isolation Division, San Francisco Hospital. 2d edition. 508 pages; illustrated. University Medical Publishers, Palo Alto, Calif., publishers, 1951. Price $3.00.

The authors of this pocket-sized book are to be commended for a superior outline of therapy. It represents a truly outstanding condensation of significant details of currently accepted methods of treatment in the field of internal medicine. The book has an excellent index for rapid reference, and contains many useful tables of reference. Both the metric system and apothecary system of weights and measures are used in the text. The common or proprietary names for medications are included in parentheses wherever this would be useful. Of particular interest is the inclusion in the text of code numbers from the "Standard Nomenclature of Disease and Standard Nomenclature of Operations" of the American Medical Association with the names of diseases. This should be helpful in the coding of records. The chapters on the general aspects of medical management; fluid and electrolyte therapy and parenteral feeding; and general symptomatic treatment are particularly well written. The book should prove of particular value to the hospital resident as well as to the busy practitioner.—*Lt. Col. W. R. Haas, MC, U. S. A.*

A Primer for Psychotherapists, by *Kenneth Mark Colby*, M. D., Adjunct in Psychiatry, Mount Zion Hospital, San Francisco; Clinical Associate, San Francisco Institute of Psychoanalysis; formerly Lecturer in Psychiatry, Department of Social Welfare, University of California. 167 pages. The Ronald Press Co., New York, N. Y., publishers, 1951. Price $3.

This primer should be required reading for all psychiatric residents, psychologists, and psychiatric social workers. It is easily read and is not encumbered by the too frequent use of confusing or controversial terms. The approach to psychotherapy is psychoanalytically oriented. Subjects discussed, with abundant case material as examples, include: the aim and basic theory of psychotherapy; psychologic appraisal of the patient; the task and countertransferences of the therapist; time and space conditions for the interview;

behavior of the patient and the therapist during the interview; a technic of beginning the therapy; the middle course of therapy (including excellent examples of how and when to make interpretations and how to handle resistances, transferences, and the working-through process); ending the therapy; and a good, practical, nontraumatic technic for psychotherapy of the ambulatory schizophrenic patient. The author is to be congratulated for his ability to present in simple and readable form the elementary principles of psychotherapy for beginners in this professional specialty. Although a bibliography is lacking, it is not really needed here as the main purpose is to give the beginner the concrete help he will need in undertaking psychotherapy of neurotic and psychotic patients.—*Col. F. R. Drake, MC, U. S. A.*

Accepted Dental Remedies Including a List of Accepted Products Together With Other Information Compiled to Promote Rational Therapeutics in Dentistry. 16th edition. 207 pages. American Dental Association, Council on Dental Therapeutics, Chicago, Ill., publishers, 1951. Price $1.50.

This report has been published annually since 1930, and is an authoritative reference book which lists those commercial products currently accepted by the Council on Dental Therapeutics of the American Dental Association and describes nearly all of the therapeutic items which are useful in dental practice. The listings conform to the standards of the United States Pharmacopeia and the National Formulary. Grouped into chapters according to their basic pharmacologic action, the drugs are discussed as to physical properties, actions and uses, and dosage. When indicated, precautionary measures and incompatibilities are described. Chapter and subchapter introductions provide a general discussion of the drugs as a group. For ready reference, there is a separate chapter on the symptoms and treatment of acute poisoning and a chapter offering useful formulas and tables. Drugs and drug distributors are listed in indexes and a bibliography is included. All dentists, aside from the study of the listed drugs, owe it to their profession to be familiar with the activities of the Council.—*Lt. Col. J. E. Chipps, DC, U. S. A.*

Militant Angel, by *Harriett Berger Koch*, R. N. 167 pages. The Macmillan Co., New York, N. Y., publisher, 1951. Price $3.

This is a warm and interesting biography of Annie W. Goodrich, the nursing profession's colorful reformer from New York. It is also a story of the development and improvement of nursing education in America. "The whole aim of this biography," writes Mrs. Koch in the preface, "has been not merely to present the facts as they occurred but to help interpret them in the light of Miss Goodrich's own warm dynamic personality; to present her, not alone as a pioneer in the field of nursing education or as a symbol of nursing in America, but the very real, human person that she is, with ideas, hopes, fears and plans for the future." The early years and later achievements through long-range vision, determination, and perseverance are described. Miss Goodrich is followed entertainingly yet accurately through the progress of nursing education from its humble beginning, when nursing students were trained on a janitorial level, to its present position and standing in the educational field. The whole transition from a purely apprentice type of learning to the academic training which marks today's standards is traced. Mrs. Koch has carefully selected and annotated her material and has told her story concisely. The titling and summarizing of the chapters facilitates reference. The book was not intended as a text but is excellent background material and would be an asset to any nursing library. It is small, easily handled, and the paper and print are of good quality. The book has an index and an extensive bibliography.

—*Capt. F. P. Thorp, U. S. A. F. (AFNC)*

960522 O - 51 - 10

Exodontia, by *M. Hillel Feldman,* D. D. S., F. I. C. A., Director of Dentistry, Lincoln Hospital, Department of Hospitals, City of New York; Diplomate of The Board of Oral Surgery, State of New York; Fellow of the International College of Anesthetists; Founder of the American Society for the Advancement of General Anesthesia in Dentistry; Honorary Member, American Society of Anesthesiologists; with a chapter on Dental Malpractice Jurisprudence, by *Michael A. Hayes,* A. B., L. L. B., Member of the New York Bar. 4th edition, thoroughly revised. 290 pages, with 322 illustrations. Lea & Febiger, Philadelphia, Pa., publishers, 1951. Price $6.50.

In this new edition of the well-known text on exodontia. Dr. Feldman has made a complete revision of the contents and, has changed many of the illustrations to show the modern concepts of surgical procedures. The book is well planned, clearly written, and covers the subject thoroughly. The author takes great pains to impress the reader with the necessity for a complete understanding of the psychic reactions which occur in mismanaged patients. He outlines definite indications necessitating extraction of teeth, also the significance of roentgenographic examination of normal and abnormal positioning of teeth. One chapter is devoted to descriptions of instruments and forceps, including the well-known patholevers which he designed. His reliance on these patholevers and his enthusiasm for them is apparent throughout his discussion of the removal of abnormally positioned teeth and root fragments. The latter part of his book deals with accidents occurring in operative procedures and postoperative manifestations following tooth removal. He also expresses enthusiasm for the use of special surgical burs which he designed for exodontic operations, preferring them to chisels in the removal of bone and sectioning of teeth. The last chapter which is new discusses dental malpractice.

—*Lt. Col. F. H. Richardson, U. S. A. F. (DC)*

Bacterial Polysaccharides, Their Chemical and Immunological Aspects, by *Martin Burger,* formerly Organic Chemist to the Bureau of Laboratories, New York, N. Y. 272 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1950. Price $6.

This is a didactic but readable text which traces the history and summarizes the present day data of the bacterial polysaccharides. The volume may serve as a reference text and also as a guide to additional study. The author presents his own views in some instances but on controversial subjects these are clearly delineated and the entire field is presented for analysis. The work is impressive in that the world literature is covered and the significant findings are presented in a terse and concise manner. The text presents a formidable summary of fundamental investigations in this field which is of interest to the postgraduate.—*Lt. Col. R. W. Satterthwaite, MC, U. S. A.*

College Health Knowledge Test, Personal Health-Form A, by *Terry H. Dearborn,* Ed. D., University of California, Santa Barbara College, Santa Barbara, Calif. 11 pages. Stanford University Press, Calif., publishers, 1950. Price, 25 copies, $2 ; 50 copies, $3.50; 100 copies, $6 ; 500 or more copies, $5 per hundred.

This test consists of 100 questions each followed by 5 suggested answers only 1 of which is best. It is divided into 11 sections: (1) social and biologic background, (2) nutrition and diet, (3) excretion and cleanliness, (4) exercise and body mechanics, (5) fatigue and rest, (6) mental hygiene, (7) reproduction and heredity, (8) prevention and control of disease, (9) hygiene of eyes, ears, and teeth, (10) hygiene of environment, and (11) the use of medical care. The test may be used at the opening of a course in personal hygiene to reveal the initial achievement of the class and again at the end to indicate how successful instruction has been. It may also be used to show which students are weak

in certain subjects. An answer key is provided and suggestions are given for scoring the test. Although it is not intended that a time limit be placed on the completion of the test, it ordinarily requires from 40 to 50 minutes. It was constructed for students of college level. It is sufficiently comprehensive and technical that it is doubtful that many physicians without a recent refresher course would make a perfect score. This is especially true since a few questions are either poorly worded or controversial. There is also a certain amount of overlapping. This test should prove valuable to those teaching hygiene in senior high school or college.—*Col. W. G. Brandstadt, MC, U. S. A.*

Introduction to Surgery, by *Virginia Kneeland Frantz*, M. D., Associate Professor of Surgery, College of Physicians and Surgeons, Columbia University; Associate Attending Surgical Pathologist, Presbyterian Hospital, New York, and *Harold Dortic Harvey*, M. D., Assistant Professor of Clinical Surgery, College of Physicians and Surgeons, Columbia University; Associate Attending Surgeon, Presbyterian Hospital, New York. 233 pages; illustrated. Oxford University Press, New York, N. Y., publishers, 1951. Price $2.75.

This little book will find its chief use in preparing the preclinical medical student for his clinical education in surgery. Most subjects are discussed in language which should be well within the grasp of the preclinical student. A broad review is made of surgical principles and a few applications to minor surgery are demonstrated. No attempt is made to cover the special surgical fields in any detail. From the standpoint of the graduate physician, too many subjects including surgical technic are considered too briefly. Some subjects such as trauma, shock, and burns are too lightly covered to give even the student sufficient information for evaluation and correlation of the things he already has learned of these subjects. The illustrations are in the form of pencil sketches and are few in number. Frequent cross references within the book and mention of topics followed by statements such as "this will be discussed later," are undesirable. On the other hand, inflammation and wound healing are well discussed in detail. An attempt is made, which is only mildly successful, to present surgical principles in a way which will relate the student to the problems he will encounter. The book is not well enough organized to be used as a standard text.—*Lt. Comdr. J. F. Adams, MC, U. S. N.*

The Eye Manifestations of Internal Diseases (Medical Ophthalmology), by *I. S. Tassman*, M. D., Associate Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania, Philadelphia; Attending Surgeon, Wills Eye Hospital, Philadelphia, Pa. 3d edition. 672 pages; with 279 illustrations including 25 in color. The C. V. Mosby Co., St. Louis, Mo., publisher, 1951. Price $12.

This new edition brings up to date an excellent book written for both the ophthalmologist and the general practitioner. The book purposely omits the detail of the standard texts of ophthalmology in order to cover in a comprehensive manner the co-ordination between the multitude of internal diseases and their ocular manifestations. As a ready reference in medical ophthalmology it fills a definite need both for the specialist and the general practitioner. The first part of the book is devoted to the anatomy of the globe and orbit, the more common methods of examination of the eye, and structural abnormalities and their manifestations. The chapter on congenital and hereditary ocular manifestations is complete and particularly valuable. The section devoted to infections and infectious diseases included a wealth of material. Each disease with its ocular manifestations is concisely but adequately covered. The last portion of the book is devoted to diseases of the blood, pregnancy, endocrine glands, the nervous system, and skin. This book includes the most recent concepts regarding glaucoma and several of the more recently described and controversial entities such as retrolental fibroplasia. The illustrations are ample and well selected.—*Lt. Col. J. H. Bristow, U. S. A. F. (MC)*

A Handbook of Space Flight, by *Wayne Proell*, Editor, Journal of Space Flight, and *Norman J. Bowman*, Ph. D., Editor, Rocket Abstracts. 185 pages. Perastadion Press, Chicago, Ill., publishers, 1950. Price $3.50.

This small volume contains a considerable amount of information in the form of tables related to research and development in the field of vehicular flight into space under gravity-free conditions. Divided into four parts, the 94 tables are devoted to properties of materials and to the physical, astronomical, and rocket phenomena involved in this subject. Data on solar and lunar gravitational potentials, satellite and escape velocities, translational velocities of atoms at various temperatures, light pressures, and meteor information are also included. There is a glossary of terms used in this research and a list of rocket and space flight societies. Though active interest and participation in the field of space flight is growing, the appeal of this book is still limited among physicians. As a reference manual, however, it is of value to those who are concerned with the broader scope of aviation medicine and flight beyond the stratosphere—*Col. R. J. Benford, U. S. A. F. (MC)*

The Education of Nursing Technicians, by *Mildred L. Montag*, Ed. D., R. N., Assistant Professor of Nursing Education, Teachers College, Columbia University; formerly Director, School of Nursing, Adelphi College. Foreword by *R. Louise McManus*, Ph. D., R. N., Professor of Nursing Education and Director, Division of Nursing Education, Teachers College, Columbia University. 146 pages. G. P. Putnam's Sons, New York, publishers, 1951. Price $2.50.

This report of a study made by the author presents a completely new idea in the education of nursing technicians. Professor Montag proposes that three distinct types of nursing service be available. Simple functions would be performed by the practical nurse or nurse's aid. Intermediate functions requiring chiefly technical nursing measures would be performed by a group known as nursing technicians and this report centers on the proposed education of this type of nurse. Complex functions requiring a great deal of insight and and judgment, the ability to plan for general nursing needs and to solve nursing needs and to solve nursing needs and to solve nursing problems, supervision, teaching, planning community health with the aid of other groups, and the execution of nursing duties which require proficiency and scientific knowledge would be the responsibility of the professional nurse. She would receive her education in a university or college and have at least a master's degree in nursing education.

Because the greatest volume of nursing service falls within the range of semi-professional or technical functions, the author proposes a new type of nursing education for this group. Instead of the customary 3-year period in a hospital school of nursing she suggests that community colleges or junior colleges provide technical nursing education. She outlines a plan for a 2-year course, the graduates of which would receive an associate degree. General educational courses would be taught by appropriate faculty members and nursing subjects would be taught by professional nurses. The demonstration and practice of nursing technics would take place in a laboratory. Hospitals, clinics, and nurseries would provide the clinical experience. Three hours of clinical experience are suggested for each hour of class study. The author states that the shorter time spent in preparation for this type of nursing would decrease the cost to the student and this would decrease the cost of nursing service rendered by this group. At present this is only a plan but it has definite educational advantages. It is doubtful, however, that this will decrease the cost of nursing service, and the time allotted for clinical experience seems too limited to develop real nursing skill.

—*Capt. Fanny E. Vlabovich, U. S. A. F. (AFNC)*

The Differentiation of Escherichia and Klebsiella Types, by *F. Kauffmann*, M. D., Chief, International Salmonella Center, State Serum Institute, Copenhagen, Denmark. Publication Number 84, American Lecture Series. 57 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1951. Price $2.

This booklet presents in brief form the author's concepts of the differentiation of organsims in the tribe *Escherichieae*. In line with the recommendation of Edwards in 1929, and the subsequent trend to which Dr. Kauffmann's work has given impetus, the *Aerobacter* and *Klebsiella* are combined in one genus whose characteristics include encapsulation, lack of motility, failure to produce indol, growth on Simmons' citrate agar, and fermentation of adonitol and inositol. The name *Klebsiella* has priority preference over *Aerobacter*. The material is clearly presented in outline form and can be followed readily by workers having some familiarity with the field, but this manual is by no means intended for the novice. The tables of biochemical reactions and the antigenic schema are easily read. Some tables are not numbered, however, and more careful editing would have improved the text. The use of meat extract in media for fermentation tests is questionable.

Biochemical reactions are used chiefly for characterizing an organism as a possible member of either genus. Antigenic characteristics define groups and types. Groups are established in each genus on the basis of somatic (O) antigens. In the *Escherichia* these are subdivided on the basis of envelope and capsular (K) and flagellar (H) antigens. An "extended" diagnostic antigenic schema for the *Klebsiella* is based on O and K antigens. A more simplified schema which employs only the capsular (K) antigens also is given. *Klebsiella* capsule types 1, 2, and 3 generally are virulent for mice and, in man, usually are associated with respiratory infections. These correspond to the familiar types A, B, and C. Capsule types 8, 9, and 10 are nonvirulent for mice and usually are associated with infections of the human urinary tract. Some O and K antigens are common to both *Escherichia* and *Klebsiella* organisms, but are given different numbers in each genus. This practice is questioned and might be avoided by desginating *Klebsiella* groups independently of the O antigen numbers.

This booklet presents the essentials of bacteriologically important work much of which has been available hitherto only in Scandinavian journals. A few pages are devoted to *Escherichia* strains isolated in outbreaks of infantile gastro-enteritis.—*Lt. Col. L. R. Kuhn, MSC, U. S. A.*

Brain Metabolism and Cerebral Disorders, by *Harold E. Himwich*, M. D., Chief, Clinical Research Branch, Medical Division, Army Chemical Center, Md. 451 pages; illustrated. The Williams & Wilkins Co., Baltimore, Md., publishers, 1951. Price $6.

The author's purpose in this book is to review the contributions to the subject of brain metabolism that have been made in recent years and were previously found only in journals. The beginner in the field of Neurophysiology, neurology, and psychiatry will find here a clear unfolding of the basic principles involved in an understanding of cellular physiology. The clinician who seeks a better understanding of the pathologic and distorted physiologic processes of the diseases that he encounters at the bedside will profit by reading this book. It is divided into two parts, the first being devoted to energetics and the second to the patterns of nervous activity. The first portion discusses the methods by which energy is elaborated as well as distributed to support nervous activity. The second portion clearly explains the application of energetics in terms of behavior.

This book can be recommended highly to beginners and to those more advanced in the fields of neurology and psychiatry and all the various ancillary groups associated with these fields. —*Col. S. C. Sitter, MC, U. S. A.*

Annual Review of Microbiology, by *Charles E. Clifton*, Editor, Stanford University; *Sidney Raffel*, Associate Editor, Stanford University; *H. Albert Barker*, Associate Editor, University of California. Volume IV. 383 pages. Annual Reviews, Inc., Stanford, Calif., publishers, 1950. Price $6.

This new edition is similar in format and subject matter to the previous three volumes. As is true of the other reviews, most of the material covered is highly specialized and not intended for the beginner. In each of the scientific fields covered, a certain amount of previous knowledge is required for understanding. A few of the chapters presuppose detailed knowledge of the field. The nonspecialist will, however, find several general subjects covered thoroughly, including historical summaries of previous work. Extensive bibliographies are given.

The subjects covered include: electron microscopy of micro-organisms and viruses; bacteriophages; constituents of mycobacteria; mutalisms in protozoa; bacterial metabolism; newer antibiotics; genetics of micro-organisms; genetics of viruses; current trends in experimental research on aquatic phycomycetes; the development of bacterial resistance to chemotherapeutic agents; chemotherapy of virus and rickettsial infections; antibiosis in relation to plant diseases; immunologic reactions in viral diseases; the immunology of the human mycoses; tularemia; brucellosis; and the influence of nutrition in experimental infection. The book also includes an extensive author index and subject index which, together with the bibliographies, afford a rapid means of further investigation into any of the fields covered.

—*Maj. G. B. Stansell, MC, U. S. A.*

Somatic Development of Adolescent Boys, A Study of the Growth of Boys During the Second Decade of Life, by *Herbert Rowell Stolz*, M. D., and *Lois Meek Stolz*, Ph. D. 557 pages; illustrated. The Macmillan Co., New York, N. Y., publishers, 1951. Price $9.

It has been less than 100 years since Quetelet first recorded data on the weight and height of French children at different ages. Reliable information on the somatic development of infants and children has come very slowly, most of the data being anthropologic. It has only been in the last 15 or 20 years that the more useful dynamic approach to growth has been emphasized. Dr. Wetzel and others have provided such data and means for the appraisal of the growth of infants and children. This volume by Stolz and Stolz provides similar information concerning the growth of adolescent boys thereby filling a gap in our knowledge of somatic growth. Measurements on a group of 67 boys was recorded every 6 months for 7 years. If the draft age is lowered to 18, some understanding of the individuality of somatic growth in the adolescent period is essential for the counseling, guidance, and training of American youth.—*Lt. Col. L. J. Geppert, MC, U. S. A.*

Orthopaedic Nursing, by *Frederick J. Knocke*, M. D., Adjunct Orthopaedist, Lenox Hill Hospital; Attending Orthopaedic Surgeon, Institute for the Crippled and Disabled; Instructor in Orthopaedic Surgery, Columbia University, New York; Diplomate, American Board of Orthopaedic Surgery; and *Lazelle S. Knocke*, R. N., B. S., Formerly Head Nurse, Women's Surgical Ward, Lenox Hill Hospital; Clinical Instructor in Orthopaedic Nursing, Hospital for Special Surgery; Instructor (part time) in Nursing Education, Teachers College, Columbia University, New York. 682 pages; 312 illustrations. F. A. Davis Co., Philadelphia, Pa., publishers, 1951. Price $5.

This book stresses the importance of considering the patient as a whole. To develop this theme, chapters are contributed by a psychologist, a physical therapist, and an occupational therapist. The introductory chapter on the

historical foundation and modern trends is particularly valuable because it orients the student to the various civic organizations that aid in the care of the handicapped. Because of its excellent reference material and questions this book will be especially useful to instructors.

—*Lt. Col. B. Elsner, U. S. A. F. (AFNC)*

Physical Examination in Health and Disease, by *Rudolph H. Kampmeier*, A. B., M. D., Associate Professor of Medicine, Vanderbilt University School of Medicine; Visiting Physician to Vanderbilt University Hospital; Chief of the Medical Outpatient Service, Vanderbilt University Hospital, Nashville, Tenn. 821 pages; 550 illustrations, 1 in color. F. A. Davis Company, Philadelphia, Pa., publishers, 1950. Price $8.

This is an orderly presentation of the fundamentals of physical diagnosis intended as an introduction to clinical medicine for the second year medical student. It begins with an adequate discussion of the anamnesis followed by a brief consideration of the "body in action" emphasizing neurologic function, and a description of the technic of the physical examination by regions, defining first the normal, then describing various departures from the normal. Many excellent photographs illustrate the text. The appeal of this book will be limited because it is concerned explicitly with essentials, and admittedly does not attempt to span the entire field of physical diagnosis. The author succeeds very well in his limited purpose.

—*Commander J. A. Forte, Jr., MC, U. S. N.*

The 1950 Year Book of Orthopedics and Traumatic Surgery (November 1949-November 1950), edited by *Edward L. Compere*, M. D., F. A. C. S., Associate Professor of Bone and Joint Surgery, Northwestern University Medical School; Chairman, Departments of Orthopedic Surgery, Wesley Memorial and Children's Memorial Hospitals; Consultant Orthopedic Surgeon, Chicago Memorial Hospital; Consultant in Orthopedics, U. S. Naval Hospital, Great Lakes, Ill. 388 pages; illustrated. The Year Book Publishers, Inc., Chicago, Ill., publishers, 1950. Price $5.

This book covers the orthopedic literature from November 1949 to November 1950 and includes many abstracts from foreign sources. A quiz sheet containing 20 questions is supplied so that the reader may appraise his current knowledge. The roentgenograms and technical illustrations are well reproduced. The editor's footnotes following many abstracts are interesting and instructive. The book opens with a special article entitled "Progress in Orthopaedic Surgery, 1940-1950." The remainder is divided into sections on poliomyelitis; congenital deformities, embryology, physiology, and anatomy of the skeletal system; the epiphysis; osteomyelitis and other infections; tumors, cysts, and fibrodysplasia; arthritis and rheumatism; fractures; the spine and pelvis; the neck, shoulder, and arm; the hand; the hip, leg, and knee; the foot and ankle; amputations and prosthesis; surgical technic; instruments, appliances, and bone banks; and miscellaneous. The Year Book may be considered a standard text in a residency training program and may be used to advantage in journal club reviews of the current literature.—*Col. H. S. McBurney, MC, U. S. A.*

Perspectives in Human Malnutrition, A contribution to the Biology of Disease from a Clinical and Pathological Study of Chronic Malnutrition and Pellagra in the African, by *Joseph Gillman*, D. Sc., M. B., B. Ch., and *Theodore Gillman*, M. Sc., M. B., B. Ch., Departments of Physiology and Anatomy, Medical School, University of the Witwatersrand; Joint Nutrition Unit of the Council of Scientific and Industrial Research and the University of the Witwatersrand, Johannesburg, South Africa. 584 pages; illustrated. Grune & Stratton, New York, N. Y., publishers, 1951. Price $18.

The authors state that their main objectives in writing this book were: (1) to focus attention on the changing pattern of the clinical and pathologic manifestations of chronic malnutrition and pellagra in Johannesburg, South Africa at various periods of life; (2) to assess the clinical and pathologic findings at different stages of the syndrome in terms of modifications in physiologic regulations; and (3) to examine the possibility that chronic malnutrition, apart from being causally related to specific nutritional syndromes, affects the life cycle of persons in such a way as to facilitate the emergence of some diseases, not usually regarded as etiologically related to nutrition, while excluding others. They accomplished these objectives in detailed discussions, excellent comments, and many illustrations of the diverse clinical and pathologic manifestations of nutritional disease. A departure is made from the usual practice of describing the signs and symptoms of malnutrition in terms of specific dietary deficiencies. Their reasons for this departure appear to be sound.

A unique feature of the book is the authors' view of the reactions of malnourished persons in terms of modifications of physiologic regulations. They use Adolph's definition of the term "regulations" which is: "a constellation of activities whereby some property or component (of the organism) is self-maintained." They add to it in stating "that regulations also exist in disease." The authors recognize two broad categories of regulations. The first apply to the organism at a given moment, and the second to the serial pattern characteristic of its development, which is immediately dependent on the first category. The first category is further broken down into three grades: (1) survival in a very restricted environment; (2) survival in a less restricted environment; and (3) survival in a widely fluctuating environment. They point out the effects of heredity, diet, and environment on regulations, and thus on the life cycle.

A large portion of the book is devoted to pellagra. One entire chapter is devoted to describing the disease and pointing out the inconsistencies that exist in its diagnosis. The authors believe that "unless the dermatosis is present then the nutritional syndrome should not be regarded as pellagra." They discuss the diagnosis of pellagra, its geographic, climatic, and seasonal distribution, the histopathology of the skin, reactions of the alimentary tract, the liver, the protein and mineral balance of the bones, plasma and tissues, the endocrines, the nervous system, and finally, its treatment.

Much space is also devoted to malnutrition other than that which leads to pellagra. Particular attention is given to chronic malnutrition which is quite prevalent in South Africa. Comparisons are also made of the various types of malnutrition which exist in different areas of the world. The final chapter discusses the prevention and elimination of malnutrition. In addition to the general principles presented, the most noteworthy observations made, which are too frequently overlooked, are the fact that (1) there is no cheap substitute for a good mixed diet; (2) diet causes disease not only by virtue of its deficiencies, but also by virtue of its contents; (3) the conditions in which a nutrient is biologically useful must always be established experimentally; otherwise much harm may be inflicted on the organism; (4) among a population malnourished for one or two generations the adults already harbor such extensive lesions in many organs that chances of cure are at present remote; (5) the science of nutrition is still in its infancy; and (6) we are still very ignorant about the principles of nutrition.

This book should be required reading for all students of human nutrition, particularly those who may be concerned with chronic malnutrition or the nutrition of large population groups.—*Maj. E. M. Parrott, U. S. A. F. R. (MSC)*

U. S. GOVERNMENT PRINTING OFFICE : O—1951

were:
logic
South
logic
as in
mal-
omes,
gence
ition,
dis-
nical
from
on in
re ap-

mal-
They
lation
self-
ase."
ly to
arac-
first
: (1)
icted
point
thus

ter is
that
is is
gra."
sonal
tract,
sues,

ds to
quite
types
apter
the
which
titute
s de-
ich a
tally;
ation
h ex-
mote;
very

ition,
nutri-

951